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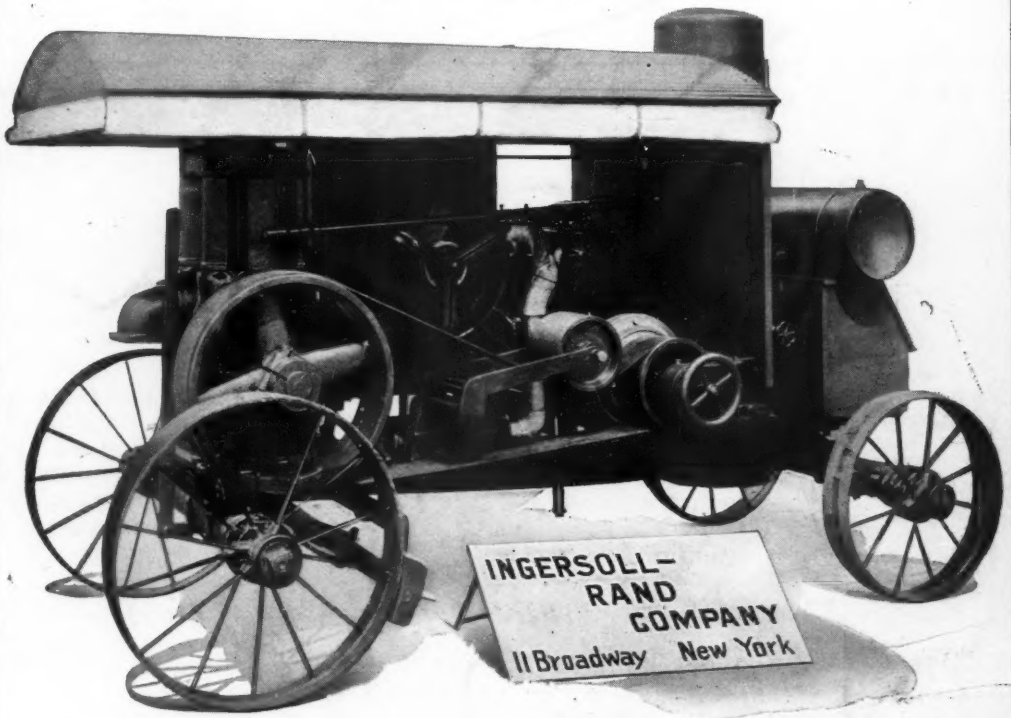

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COMPRESSED AIR MAGAZINE

Vol. XXIV JULY, 1919 No. VII

Education in Compressed Air Practice

By FRANCIS JUDSON TIETSORT

ANNOUNCEMENT was made in last month's issue of this magazine of an effort by the editors to ascertain the sentiment of educators, manufacturers, engineers and others, on the subject of additional educational facilities in the field of compressed air. In addition to the published announcement, letters were sent out to the heads of schools of technology, university engineering departments, mining schools, and to individual engineers and other recognized authorities. In this circular communication the editors announced their desire to obtain the views of those addressed as to whether it was advisable to have established a chair, or special course of teaching, in one or more of the schools of technology or universities of the United States. Attention was called to the fact that applications of compressed air in the greatest industries of the United States, as well as throughout other industrial nations, had now become so manifold that special knowledge on the subject was becoming indispensable.

F. J. TIETSORT.

We expressed it as our belief that the topic was one that was holding the attention and deep interest of engineers, of all users of compressed air equipment, manufacturers of compressed air and pneumatic apparatus, salesmen, contractors and of students themselves. We inquired for opinions as to: (1) a special addition to the curricula of the technical schools; (2) what the proposed course should consist of; (3) whether there should be a chair of compressed air engineering, special instructors, or what; (4) what institutions such a course should be given in.

Our inquiries originated as the result of expressions from engineers connected with large industrial houses to the effect that there was sometimes a real difficulty in obtaining the services of young engineers that were well-grounded in the details of compressed air practice.

At the outset we should make plain that there has been no thought expressed that general engineering knowledge should be subordinated to a secondary position; the intelligent application of compressed air principles in everyday practice involves, of course, too many demands upon the great general field of mechanical engineering. The uppermost idea has been to obtain views, from various angles, of men well versed in the subject, for the benefit of our readers, in order that they might form their own conclusions.

As the result of these inquiries it may be possible for someone to suggest an intelligent programme for making compressed air education more available for students who may desire to enter either the field of compressed air machinery manufacture, or other fields wherein compressed air and pneumatic devices are largely utilized. The benefits accruing both to the man who enjoys this specialized knowledge, and to his employer, are so obvious that they are not a subject for debate.

We are quite aware that many of our technology schools and universities are already giving a very considerable amount of attention to compressed air. We are rather astonished, however, at the great number of replies and the variety of replies that our symposium has called

forth. We note a pronounced disposition on the part of educators, one with which we feel in accord, not to allow any one specialty to interfere with the absorption by the student of general engineering knowledge. There seems to be in some cases a disposition to make a special course on the subject an *elective* postgraduate course, and possibly that is a solution for certain schools. Under such conditions there seems no objection to it as a special curriculum, though the thought of a "chair of compressed air" has fewer proponents. Such a chair, granted a sufficient endowment, might prove a success and warranted, in such an organization as that of the Massachusetts Institute of Technology, but, in most cases, college faculties and trustees are not likely to favor a "chair," and for obvious reasons.

We shall be happy, if, in our soundings of opinion, we shall have created a sufficient sentiment to instigate action looking to the educational betterment sought. There are many wealthy men connected with the compressed air machinery industry, as well as in those lines of manufacture in which this elemental plays an indispensable part. A large percentage of these gentlemen are engineer alumni of famous schools. It is not impossible that some benefactor or group of benefactors may properly estimate the importance of the need and take the step required to meet it from the manufacturer's viewpoint. Additional endowments in the cases of some schools, may prove unnecessary. Still, whoever heard of a school that did not need more funds!

Judging from the response to the announcement made by COMPRESSED AIR MAGAZINE, which was so large that we find it impractical to publish all of the replies in this issue, the original conception of the importance of the subject was not far from accurate. We take pleasure herewith in presenting some of the replies received; others will be made public in the August issue.

Views of Leading Authorities

By RICHARD C. MACLAURIN
President, Massachusetts Institute of Technology

The questions raised in your letter of May 19th are of special interest to this Institute which realizes the growing importance of the use of compressed air in various industries of the country. Familiarity with the subject is deemed of such importance that it now occupies a considerable portion of the course in Mechanical Engineering here. *This course attracts a larger number of students than any of our engineering courses* and these students are picked men who come from practically every State in the Union.

The students in our course in Mechanical Engineering are made familiar with the fundamental principles of the thermodynamics of gases and of the different methods of compressing air. This course deals with such matters as the effect of clearance in compressors, displacement efficiency, the efficiency of compression, the temperature at the end of compression, the saving made by two-stage compression and the proper pressure to be carried at the end of the first stage in order equally to divide the work between the two stages, similar calculations for a three-stage machine, method of lubrication of the compression cylinders, use of oil, soft soap, etc., the transmission of compressed air in pipes, the flow of compressed air through orifices and thin plates and the method of testing a compressor for its displacement efficiency, etc., the measurement of air under low pressures, the effect of humidity of the air, the use of compressed air in Pohlé air lifts and in pneumatic tools.

In all cases the matter is dealt with partly by lectures but largely by experimentation in well-equipped laboratories.

What is mainly needed now is the provision of *further facilities for research. The endowment of a chair of compressed air engineering would be particularly useful* if the occupant of the chair were given opportunities *to carry on and direct research* and were charged with the duty of caring for the interests of the relatively small number who would really profit by greater specialization during their student days than is indicated in the outline of the course that I have referred to above.

It would, I believe, be a mistake to encourage specialization at the expense of a broad training in the things that are fundamental in the great profession of Mechanical Engineering.

By ELMO G. HARRIS
Professor of Civil Engineering, School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

In the discussion about putting a course in compressed air in one of the universities, I offer the following:

For the last ten years the Missouri School of Mines, has given a course in compressed air, consisting of one semester (4½ months)—two lecture periods per week and one afternoon for special problems and laboratory work. Up to two years ago it was required in the mining course. It is now elective. Alumni writing back express appreciation of the course—so much so that we feel that the time has been well used.

It is the writer's opinion that a course in compressed air should be offered (as an elective perhaps) to students in mining and in mechanical engineering. The subject would logically follow thermo-dynamics. It should be confined (except in laboratory work) to the fundamentals—chiefly mathematical. Few engineers will master the elusive mathematical laws governing the control of air (compressed or not) unless under the tutelage of professors.

The writer is less sure about the advisability of giving much time to study of special machines. They are too transitory. Such work might be confined to vocational training.

By E. J. McCAUSTLAND
Dean and Director, School of Engineering, University of Missouri, Columbia, Mo.

In answer to yours of May 19 in the matter of the establishment of a chair or course of teaching for compressed air in the schools of technology in the United States:

There can be no question that the applications of compressed air are becoming so varied and important that special knowledge must be acquired by men who hope to succeed in that branch of engineering.

The problem you propound is one not easily answered in an offhand manner. In the first place, I believe most educators will agree that a long period of training in the fundamentals of science should precede the study of special applications in any specific field. It would appear therefore, that an adequate treatment of the subject of compressed air should take its place as a special addition to be made in some curriculum of a technical school, most suitably, perhaps, as part of the mechanical engineering curriculum. Mathematics, including the calculus, physics with special work in the subject of heat and a strong course in theoretical thermodynamics would prepare the student for the applications of compressed air in the industries.

I cannot at this moment pretend to suggest the scope of the proposed course, but answering your question as the wisdom of establishing a chair of compressed air engineering or special instructors, I should say that this would be wise *only in case the school was likely to furnish enough students in the particular field to occupy the time of an expert and was sufficiently well equipped in its laboratory facilities to enable such expert to carry on work that might be with justice classed as research work.* To conduct a course that merely describes installations and equipment would, I believe, be less effective than to direct the student into some industrial activity making use of compressed air machinery. On the other hand, to place the student in a well equipped laboratory and encourage him to carry on investigations, original with himself at least, is an excellent means of fitting such a man to take his place in the industries as a valuable employee.

It follows from the above that only such institutions as are well equipped with funds should attempt to offer such a special course.

By MORTIMER E. COOLEY
Dean Colleges of Engineering and Architecture, University of Michigan, Ann Arbor.

The subject of compressed air has, in my opinion been too much neglected in our engineering college curricula. It has been crowded out by subjects considered more important. Just at the time compressed air was forging to the front, electricity came into practical use. With new subjects constantly arising, engineering curricula gradually became crowded, and now four years is not enough time for fundamentals alone.

The literature on compressed air, thirty to forty years ago, was becoming voluminous. A great deal had been done on transmission at low pressures. But curiously enough, nothing has been done on transmission at high pressures.

We, at one time, specialized here to some extent in compressed air; that is, we offered courses in the subject and also in mechanical refrigeration. That was twenty-five or thirty years ago. I taught the subjects myself.

When our new engineering building was planned in 1902, we provided for experimental work in air under high pressures, 2000 lbs. per square inch, and above. A mile of extra heavy pipe was to be installed at the ceiling of our naval tank in order to determine losses in transmission at high pressure. Later, we purchased a compressed air plant built for one of the dynamite cruisers of the Navy, and later used by the Union Traction Company of Chicago to propel street cars. The compressors were rebuilt and installed about 1908.

It is to be regretted that the tests contemplated have never been made. Overcrowded curricula, large numbers of students and overworked faculty are the chief reasons.

I should hardly think it desirable, at the outset, to establish a Chair of Compressed Air Engineering. It might be offered as one of the branches of thermodynamics, or as a course entitled Compressed Air.

If a Chair of Compressed Air Engineering is to be established, it might be well to confine it to one or two institutions and make as much of it as possible. Engineers desiring to specialize in compressed air could go to that particular institution.

The institution selected should be from among those leading in engineering, and it should have the cordial support of all the others in helping to develop the course.

It would be well to have those particularly interested come together to work out the character of the course, its scope and the method of teaching it.

By P. F. WALKER
Dean, School of Engineering, The University of Kansas, Lawrence, Kas.

In reply to your letter of May 19th regarding the teaching of compressed air in universities:

1. Shall a special addition be made to the curriculum of the technical school? Only in a brief way to supplement existing training courses.

2. Of what shall the proposed course consist? A few lectures and applicatory problems in regular designing.

3. Shall there be a chair of compressed air engineering; no; special instructor may be necessary in large schools.

4. In what institution shall such a special course be given? So far as indicated above, in any school.

In the above it is not meant that the topic is not one of vital importance. Educational tendencies, however, are in the direction of renewed emphasis on general fundamental sciences. It seems to us more appropriate for manufacturers of compressed air machinery to open special schools, as so many other groups of manufacturers have done.

By H. V. CARPENTER
Dean, Mechanical Arts and Engineering, State College of Washington, Pullman, Wash.

Answering your inquiry of May 19th regarding the desirability of establishing a chair or course of teaching covering the subject of compressed air, I wish to make the following suggestions:

You could to good advantage take steps to encourage the listing of more elective courses, especially courses including laboratory practice in the curricula of Mechanical Engineering schools. You could arrange for a committee of those best qualified to investigate the possibility of establishing in perhaps two or three prominent engineering schools of a group of courses, which would permit students to specialize in more difficult problems arising in the application of compressed air.

It seems to me very likely a well equipped research laboratory studying the possibilities for any applications of compressed air might meet with success in quite a number of good directions.

From CHARLES H. SNOW
Dean, School of Applied Science (Engineering), New York University, University Heights, New York

In reply to your invitation of May 19th I enclose herewith a report made by Dr. Daniel W. Hering who had to do with, what I believe to be, one of the first attempts to organize a course on compressed air.

It may interest you to know that one of those who took this course was Mr. W. W. Wotherspoon, N. Y. U. '98, who has since had much to do with the salvaging of ships by compressed air.

Please feel free to arrange this material as may seem best to you. I am sorry for the pressure that makes it necessary for me to send it in as it came to me.

NEW YORK UNIVERSITY, May 26th, 1919.

Dr. Charles H. Snow,
Dean of the School of Applied Science.

DEAR DR. SNOW:—While I do not feel at liberty to answer directly the letter you received from the Managing Editor of the COMPRESSED AIR MAGAZINE, I am writing you some of my views concerning the propriety of including compressed air specifically in engineering instruction, of which you are at liberty to make such use as you may see fit. Certainly the magazine is making a good move. Through Messrs. Saunders, Richards, and many other active, capable engineers who have worked with it and for it, it has done great service to engineering practice. In connection with the subject of this letter, as long ago as October, 1908, it spoke of New York University as being exceptional among educational institutions in offering a course in compressed air and its applications.

How far it is desirable or expedient to go in dealing with a special subject is for each institution to decide for itself. There would be abundant material, and a field broad enough and sufficiently diversified for an elaborate treatment of the subject of compressed air, but it does not seem to me that it would be any more appropriate to make a special type of engineering of it, than of, say, railway surveying, which has been extensively developed, or of explosives, or of the manufacture and use of dyes, or of paints. But to such an extent has compressed air come into the service of the engineer, and so great a part does it play in determining both the economical performance of a piece of work and the quality of the work when finished, that no civil or mechanical engineer today is well qualified for practice who has not had some training in this subject. I think no considerable piece of engineering work is put through nowadays, in which compressed air is not an important factor.

Inasmuch, however, as it rests upon fundamental principles, mathematics, physics, and applied mechanics, which are the same as those of other branches of engineering, namely, mechanical engineering, bridge engineering, and engineering construction generally, I would not make this a separate type of engineering, but would provide a course in this subject which should take it up technically only after the student has had good training in his chemistry, mathematics, and physics; say, not before the third year of his engineering course.

Then some portions of this work, like thermodynamics, and the use of the indicator would coincide with what he was studying in connection with other branches of engineering. I may say, however, that I found that the students in steam engineering were so imbued with the conditions attending the expansion and cooling of steam, that they were confused rather than helped by it when it came to considering the compression and accompanying heating of air.

My own experience in presenting the subject at New York University extended over nearly twenty years, and while it never reached the rank to which I thought the subject was entitled, it enabled me to get pretty definite ideas of what would be suitable for it in a good engineering school. It began with us in a very moderate way, with senior engineers,—simply a brief course of lectures, six or eight, supplementing others on the production, measurement, and transmission of power. Year by year the work in compressed air was expanded and systematized, until it comprised about twenty-five lectures, besides occasional laboratory experiments or demonstrations.

The course consisted of first a generally descriptive and historical account of *applications*, fully illustrated, showing the great variety of ways in which the engineer utilizes compressed air; then, a more intense, careful, detailed discussion of the theoretical principles, with quizzes, and numerical practical problems relating to temperatures, power, economy, mechanical efficiency, etc., and some indicator tests, and inspection of compressed air features in engineering work then in progress. Good examples were the Jerome Park reservoir, and the cleaning of the 155th street viaduct by the sand blast.

In a more complete handling of the subject, probably refrigeration would find a place, and other important topics to which I could only allude, and perhaps regular lessons from a text book would be of advantage. I must say, however, that I know of no one text book that would satisfy me. My work was entirely with seniors, and I think it properly belongs to the student's senior or junior year.

Even with the limitations under which I gave the lectures, I believe they were worth while. With the great expansion of compressed air practice since I first took up the study, I do not see how it can be omitted from the engineer's training. It should have a fully recognized status in the curriculum, and a foundation that would support such a course of instruction, not omitting practical work in a suitably equipped laboratory, would add much, in my opinion, to the completeness and value of the work of the institution giving it.

Somebody must have thought my work desirable, for, as perhaps you know, my entire illustrated manuscript of the course was appropriated, and has disappeared. I have felt its loss very keenly.

Sincerely yours,

D. W. HERING.

By C. R. RICHARDS
College of Engineering, University of Illinois, Urbana-Champaign, Ill.

In reply to your letter of May 19 in regard to the importance of increased attention to the subject of compressed air in the engineering curriculums of our technical schools, I beg to submit the following:

1. In my opinion it would be unwise, if not undesirable, to establish a special curriculum in compressed air engineering. I do not think enough students would be interested in such a highly specialized course to justify the colleges of the country in undertaking it.

2. Practically every curriculum in mechanical engineering now gives considerable attention to problems

the principles of mechanism and in machine design as well as in the use of a great variety of air appliances in our Shop Laboratories.

3. I should not consider it essential that there be a chair of compressed air engineering, or that instructors be appointed to handle this subject to the exclusion of others. We have a number of men in our Department of Mechanical Engineering who are well informed concerning the theory and practice in this work.

I have always been tremendously interested in the subject of compressed air. I have already prepared one bulletin of our Engineering Experiment Station, entitled "Entropy—Temperature and Transmission Diagrams for Air," and we have two manuscripts devoted to certain phases of compressed air utilization, which we hope to publish in due time.

By F. PAUL ANDERSON
Dean, College of Engineering, University of Kentucky, Lexington, Ky.

I believe it would be a very desirable move to have a special course in compressed air engineering in one or two of the universities in the United States. This course could be an under-graduate course leading to the degree Bachelor of Science in Compressed Air Engineering.

I am opposed to having too many special courses in the undergraduate engineering course. I believe in a basic fixed course for engineering, with no electives. If a special course in compressed air engineering existed in some one or two universities, the course could be so arranged as to allow men to go from various engineering schools and take a post graduate course. The degree should then be Mechanical Engineer. I appreciate fully that the average course in mechanical engineering does not have enough time to give to engineering problems pertaining to compressed air practice.

By WILLIAM PRELLWITZ
Chief Engineer, Ingersoll-Rand Co., Phillipsburg, N. J.

Referring to your letter of the 19th, asking about the establishment of a chair or course of teaching for compressed air in one or more of the universities or schools of technology in the United States, note that the writer has no opinion to offer in reference to this.

Personally we do not think a special course in compressed air engineering is required as much as a good course in thermodynamics, and in that course give a little more detailed attention to its application to air compressors and this will answer all as regards theoretical learning that is required.

As regards its practical application, the course could include the proper installation of air compressors, including their pipe lines, air receivers and the advantages in aftercooler to take out the moisture, and the course could further include all the application of compressed air.

By F. W. ATKINSON
President, Polytechnic Institute, Brooklyn, N. Y.

There are very few institutions where a special professorship or even instructorship in compressed air would be advisable. The fundamentals of compressed air operations are covered in the course in thermodynamics; some practical experience is given in the Mechanical Labarotory work; and this, I believe, is sufficient for the education of under-graduate mechanical engineers.

Further training in the subject would fall under the head of specialized training, which is not advisable.

The subject of compressed air might very well be made a major for a graduate degree, and for those schools doing a great deal in graduate work, that might be desirable.

By F. A. JIMERSON
Chief Engineer, Ingersoll-Rand Co., Factory, Athens, Pa.

Replying to your inquiry of May 19th I believe that a short practical course in compressed air engineering would undoubtedly be of value to a great majority of mechanical and mining engineering students. To the best of my knowledge no special courses are offered along these lines, although a certain amount of theory relative to compression and expansion of air is usually taught in the thermodynamic courses.

The average technical graduate leaves school with no practical knowledge of the application of compressed air to the industries. In fact, he more than likely to believe that compressed air is a thing of the past dying a hard death because of the development of electrical machinery and appliances.

A study of the shipbuilding industry, of the railroads, of machine shops and of foundries will convince the most skeptical that compressed air is secondary only to steam and electricity as applied to the above and many other industries.

Nearly every engineering student elects or is required to take a course in hydraulic engineering, very likely he elects a course in water turbine design and follows with laboratory work. Nine times out of ten he has no opportunity to apply this knowledge in later life. Examples of other courses offering much less of practical value to the average man than a knowledge of pneumatic machinery might be mentioned, but I merely desire to bring out the necessity of introducing into the curricula of technical schools practical, not theoretical, courses in compressed air engineering and the application of compressed air to the industries.

By JOHN R. ALLEN
Dean, College of Engineering and Architecture, University of Minnesota, Minneapolis, Minn.

I have your favor of May 19th in regard to having a chair in compressed air. I was connected with the University of Michigan for about twenty years and for a number of years gave a special course in compressed air and compressed air machinery. Personally I do not believe in establishing a course in compressed air engineering.

I do not believe that there is any such thing. A man to properly do his work in compressed air lines should be a thoroughly trained mechanical engineer, particularly should his course embrace thermodynamics. In addition to that he might have one or two special courses in compressed air and compressed air machinery.

I think this is as far as any college would be warranetd in going in a specialization of this kind.

By ROBERT PEELE
Professor of Mining Engineering, School of Mines, Columbia University, New York Ctiy

Responding to your letter of May 19, I would suggest the following considerations regarding the proposal to establish a course of teaching in compressed air engineering.

1. The principles of air compression, and the transmission of power by compressed air, are now given thoroughly in several technical schools, as a part of the newly-develpoed subject of "Engineering Thermodynamics."

2. The salient details of the design and operation of compressors and their accessories, from the stand-

point of the user, are included in well-conducted courses in Mechanical Engineering.

3. The courses of study in technical schools covering the elements, principles and practice of Mechanical Engineering as a whole, are already seriously overcrowded.

It should be remembered that these studies must be preceded by a long period of training in Mechanical Drafting, Mathematics (up to and including Calculus), Physics, Mechanics, Properties and Resistance of Materials, Graphic Statics, and other fundamental subjects.

Furthermore, in a well planned curriculum, the laboratory work accompanying these courses occupies the afternoons of about two years, added to which is summer vacation work in Shop Practice and Machine Design.

4. The field of present day Mechanical Engineering is so wide that to attempt to make a specialty of any one branch would prevent a thorough drill in the fundamental subjects.

5. I think it would be undesirable to establish a special course in compressed air engineering. The details of the subject, including design of the machinery, uses of compressed air, etc., would best be left to a period of training in the shops of makers of compressors and rock drills; this training to follow the courses of study given in technical schools.

By MERTON L. EMERSON
Vice President, American Pneumatic Service Company, Boston, Mass.

Referring to your letter of May 19, I am giving my personal views on the subject of the establishment of a chair, or course of teaching, for compressed air in one or more of the universities or schools of technology in the United States.

The only training in "Compressed Air" given in most scientific institutions is the basic course in thermodynamics which is later followed by courses in steam engineering.

I can see no field for a class of compressed air engineers as, for example, similar to the existing class of electrical engineers; but I believe that in all general engineering courses the same relative attention should be given to compressed air engineering as is given to steam engineering.

Too much attention cannot be given, first of all, to the present courses in thermodynamics. I would suggest that half the time that might be applied to a course in compressed air engineering be given to a further study of thermodynamics. Then, with this absolute grounding in theory, the balance of the available time could be well divided between lectures and laboratory work.

The lectures, say ten in number, should, I believe, cover the general application of compressed air in the industrial field and could well be given by experts in the different lines of such application. The laboratory work should in general follow the practices governing any steam engineering laboratory work.

Any large technical school could well have a professor of compressed air engineering, just as well as they have a professor in steam engineering. Students in the general courses of mechanical, electrical and civil engineering should be allowed to *specialize in such a course as an option,* just as they are now given other options in their respective courses.

The policy should be, however, to educate young engineers on the basic principles of theory and practice and to let them become specialists at a later time if they are so qualified.

By ALBERT M. GREENE, JR.
Professor, Department of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute, Troy, N. Y.

We have your letter of May 19th and in reply to this we would state that in our course in Heat Engineering given to Mechanical Engineers and Electric Engineers, we take up the problems in compressed air. This work considers the methods of compression, power required to compress air under different conditions, losses in air transmission and application of compressed air to air motors. In our Mechanical Engineering Course our men test and examine a two-stage air compressor. We believe that the amount of work we give to compressed air is sufficient for the general mechanical engineering training.

Although the use of compressed air is extensive and the applications numerous, we do not believe that it is wise to make any further addition to the curricula of the technical schools. There is entirely too much specialization in our schools, and what we need is to have thorough ground work done, and the men taught to think. If they have the fundamentals well assimilated and know how to think it takes but a short while to learn the peculiarities of any special branch of engineering.

For this reason we believe that a chair of compressed air engineering with special instructors is entirely out of place. Many of the leading engineers in the works where compressed air machinery is built and developed have had a general mechanical engineering course, and I am sure these men would agree with me that a strong general course in engineering is much to be preferred to a special course in compressed air engineering.

By A. G. CHRISTIE
Associate Professor, Dept. of Engineering, Johns Hopkins University, Baltimore, Md.

We recognize the growing importance of compressed air in the arts and industries, and feel that something should be included in our technical courses covering this subject. We have recently had a long discussion on the subject contents of our courses and have come to the conclusion that we can give a better all-around engineering training by sticking quite closely to the main fundamentals of engineering, and leaving the special studies for graduate work. We have therefore included among our advanced graduate courses such special studies as refrigeration, gas engines, steam turbines, advanced production engineering, compressed air, and so on.

Referring to the specific questions which you have asked, I would say therefore that we do not believe that an addition of another course in compressed air is possible in our under-graduate curriculum, although it has a legitimate place in our advanced studies. The course which I have in mind for this advanced work will consist of a thorough study of the thermodynamic relations of air, or air compressing machinery; a study of its functions in the laboratory, and the applications of compressed air.

It seems to me that a great deal of help could be given to the colleges by manufacturers of compressed air equipment if arrangements were made to furnish laboratory apparatus and demonstrating equipment of their products to the various colleges.

I have in mind one of the large laboratories in Germany, which was furnished with a very elaborate equipment of air compressors and compressed air machinery, and where tests and research work were done on the power required to drive various compressed air tools.

on air compression and transmission. This is true at the University of Illinois, and I feel confident that it is true in other institutions. Our students secure a good understanding of the principles involved in compression and expansion of compressed air, and we give considerable emphasis to the transmission of gases and vapors through pipelines. We do not give very much attention to machines designed to use compressed air, but this does not seem to be essential, since our students receive a thorough training in

You ask whether a chair of compressed air engineering should be founded, and at what institution. If a specialized course is considered, I should think that it could only be founded at one of the largest of our universities where considerable graduate work is possible, such as Massachusetts Institute of Technology or Cornell, or possibly one of the Western schools, such as Wisconsin, Michigan or Illinois.

By GEORGE M. RICHARDS
Yarnall-Waring Co., Philadelphia

We beg to advise that we are in full accord with you in the establishment of a Chair or University Course in Compressed Air Engineering.

In view of the present wide and constantly broadening field for compressed air such a course should embody all the uses it is now put to as well as its future possibilities.

As we have come in contact with more graduates of Cornell University and the Massachusetts Institute of Technology who are in some way specializing in this particular branch of engineering, we naturally would give the preference to either one of these institutions.

By ALBERT W. SMITH
Dean, Sibley College, Cornell University, Ithaca, N. Y.

For many years we have realized the importance of the subjects of compressed air for students of engineering, and in connection with our courses in Heat Power Engineering we have been giving some special attention to this subject. We shall continue to develop the teaching as the importance increases.

It does not seem to the writer necessary to establish a special chair of compressed air in engineering as it is distinctly a part of another subject. All men who graduate from Sibley College have received a fundamental training in connection with this subject, and I believe this is a foundation upon which to build further knowledge should their experience in practical life demand it.

By EDWARD ELLERY
Dean of the Faculty, Union College, Schnectady, N. Y.

In reply to your letter regarding a course in compressed air engineering in our educational institutions I would state that it seems to me the purpose of such a course would be realized either by including the subject in some part of a mechanical engineering course already offered or by a series of lectures on the subject by some expert in a given period of the scholastic year. I do not believe that the subject should be added to the curriculum as a distince course.

We find the views thus far expressed of ready interest and are hopeful that they will stimulate a further discussion of the subject throughout the entire field of compressed air. We shall be pleased to receive further expressions from our readers.

The majority of responses indicate that if there is to be the foundation of a chair of compressed air it logically might be in connection with the Massachusetts Institute of Technology or some leading university having a large number of engineering students. Some of the replies received would indicate that their writers were under the misapprehension that the thought involved in the discussion was that *every* institution with a college of engineering should have a special course in compressed air. This idea is in error, as reference to the symposium questionnaire will show.

AIRPLANE DIRECTION FINDER

The problems involved in the safe and successful navigating of the air are far more complicated and difficult than is generally appreciated. One of the most important of these problems was presented in a recent lecture by Maj.-Gen. G. O. Squier before the American Institute of Engineers.

One of the principal problems of airplane navigation, said Gen. Squier, has been the evolution of a suitable compass, particularly for night landing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning.

The use of directional effects of loops or coils for receiving radio signals has resulted in the development of a radio compass for airplanes which gives positive information to the aërial navigator and enables him either to locate his position by triangulation with respect to two beacon land stations or to fly at any given angle with respect to a certain beacon station.

The apparatus consists of two principal parts —the antenna coils and the turning and amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley-Page airplane, with suitable means for rotating in azimuth. The amplifier is extremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of the amplifier is the use of iron-core transformers for frequencies of 100,000 cycles.

The direction of the beacon land radio station is determined by maximum strength of signals, in a highly ingenious manner developed originally by the British. The precision of the directional effect is remarkable. In fact, the radio direction finder may well be called a radio eye, by which the aërial navigator sees one or more radio lighthouses which are sending identifying signals to guide him on his way. These lighthouses, furthermore, have certain advantages over the normal lighthouse in that their ranges may be much greater and they are not invisible in the daytime nor obscured by fog and mist.

Building Steam Shovels With the Aid of Air

By WALTER P. BURN

IN THE YEAR 1884, a small plant in the town of Marion, Ohio, started to build steam shovels. At that time the steam shovel was a new device and there was little or no competition. Today, despite the great number of other firms manufacturing the same products, the Marion Steam Shovel Company dominates the town of Marion, and is the very life and center of it.

W. P. BURN.

The plant occupies seventy-five acres of ground, and is complete within itself. That means that it has its own open hearth steel and manganese steel furnaces and foundries, its own boiler, structural and fabricating plants, its own iron, brass, bronze and aluminum foundries, its own chain shop, lumber yards and saw mills—in fact, every department necessary to convert raw materials into the finished product.

Building steam shovels at Marion is an art. The matter of boiler capacities, engine horsepower, proportions of crane and dipper handle, ratios of gearing and the like, were long ago reduced to a science. So, for the last few years the problems of refinement of the product have received most careful attention; every effort has been made to produce a steel, for example that will be the ideal material for the dipper, a different steel for the gears, a perfect bronze for bearings.

The effort to improve materials is perhaps best illustrated by the steam shovel chain made at Marion. The chain is made entirely by hand, and each weld is made in two heats to insure proper annealing and prevent setting up of unnecessary strain in any link. The most interesting feature of Marion chain, however, is the stock from which it is made. To produce the material, square bars of pig iron and of soft steel with wrought iron scrap are piled up in the manner shown in Fig. 1—the black squares representing iron, the lighter steel. The piles are then bound together and rolled, producing a round stock which has a cross-section like that of Fig. 2. It is claimed that this stock has all the advantages to be derived from the toughness and resistance to shock of the steel, and the resistance to wear of the pig iron. The double "working" of the material doubtless enhances its toughness also.

In addition to improving materials, the Marion Steam Shovel Company has made every effort to increase the efficiency of its foundries and shops. To this end, compressed air has been extensively employed, and once more demonstrated its value as an aid to efficient production. Almost every step in the making of the steam shovel involves the use of air tools.

The first step in the construction of a steam shovel is the building of the frame. This requires careful design, as it bears all the shocks of operation. In the Marion Shovel, the frame is constructed of four large I-beam sills connected by deep separators of heavy cast iron. The solidity of the frame is so important that the separators are machined to fit the beam contours exactly before the parts are riveted together. Four tie-rods to each set of separators give additional strength to the frame.

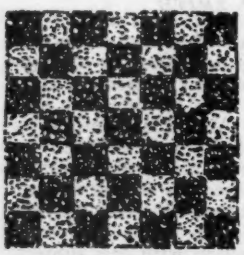


FIG. 1.

FIG. 2.

The car frame is placed upon heavy cast wheels, tractors with spur gearing or railroad trucks, and upon it is mounted the rotating frame. The latter consists of a one-piece steel casting to which is solidly anchored an extension framework of beams and channels firmly riveted together.

The boilers used are mainly of the locomotive water-tube type, although a fire tube boiler is used on some of the smaller shovels. The boilers are built in the Marion Shops almost exclusively with air tools, the latter being employed for reaming, riveting, rolling and beading the flues, tapping for staybolts, and caulking seams, rivet and staybolt heads. In the assembly of the shovel, the boiler is mounted upon the swinging extension framework.

Operating machinery comprises a swinging en-

1.—DRILLING OAK PORTION OF DIPPER HANDLE WITH PNEUMATIC WOOD-BORING MACHINE.
2.—PNEUMATIC SAND RAMMER AT WORK IN MARION FOUNDRY.
3.—COMPRESSOR INSTALLATION OF MARION STEAM SHOVEL PLANT, CAPACITY ABOUT 3,000 CU. FT. OF FREE AIR PER MINUTE AT 80 TO 100 LBS. PRESSURE.
4.—DRILLING FLOOR FOR ANCHOR BOLTS WHEN ASSEMBLING.

gine, used for propelling the shovel and swinging the revolving frame as well as operating the boom; a hoisting engine for manipulation of the dipper; and crowding engines for adjusting the shipper shaft.

The hoisting and swinging engines and hoisting machinery are secured to the main rotating frame casting. Their functions are easily understood, as the swinging engine serves to swing the revolving frame so that the boom extends in any desir-

1.—PORTION OF MACHINE SHOP SHOWING STRAIGHT LIFT AIR HOISTS EMPLOYED.
2.—TRIMMING CASTINGS WITH A PNEUMATIC CHIPPING HAMMER.
3.—RIVETING EXTENSION FRAME OF A STEAM SHOVEL.
4.—TAPPING BOILER FOR FLEXIBLE STAYBOLTS WITH A PNEUMATIC DRILL.

ed direction, and the hoisting machinery raises the dipper up and down by means of cables passing over the upper end of the boom and secured to the dipper itself.

The crowding engine is a small engine mounted on the boom at the fulcrum point of the dipper handle, and serves to shorten or lengthen the leverage of the dipper by changing its point of balance. It operates through a gear driving a rack, called the shipper shaft, attached to the boom.

The hoisting engines are double, equipped

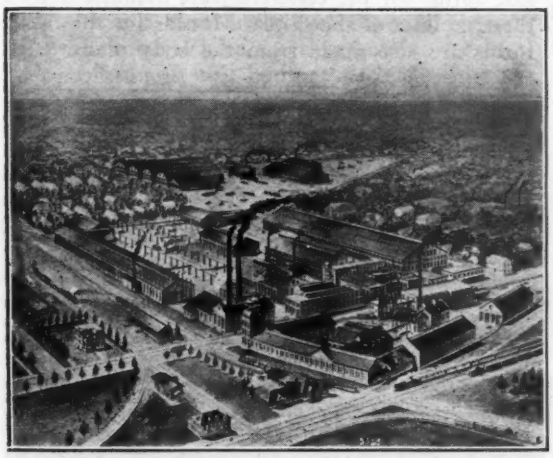
with link reverse, and connected to the drums by friction bands. The bands are operated by a steam ram in order to relieve the operator of all strain.

All machinery except the main engine, hoisting engines and crowding engine is mounted on the extension of the swinging frame.

The boom is built of seasoned oak, heavily reinforced with steel plates on top and bottom extending over its entire length and firmly trussed together. At the base is attached a heavy open-hearth steel casting to give strength and stability.

The dipper handle is also of the combination oak and steel type and reinforced with steel bars, top and bottom. The racking is made of a special manganese steel and is firmly secured by through-bolts to each number, besides being riveted to the bottom bars. In the making of both the dipper handle and boom, pneumatic tools are extensively used for riveting, chipping and wood boring.

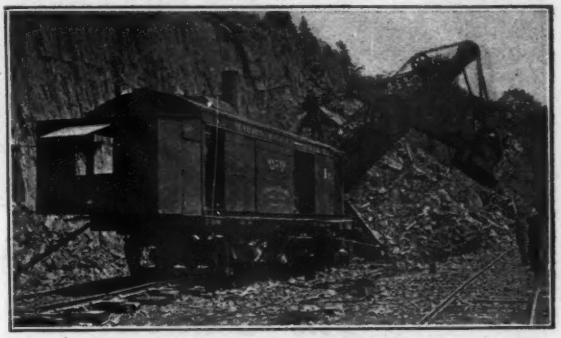
The dipper itself is made of open-hearth steel with the exception of the jaws, which are of a special manganese steel. The need of a hard, tough material for the jaws is obvious when it is considered that they are often required to cut through hard shale or similar material.



"AIRPLANE VIEW" OF THE PLANT OF THE MARION STEAM SHOVEL CO. AT MARION, OHIO.

The use of air tools in the making of a steam shovel is even more extensive than has been indicated. In the foundry, pneumatic sand rammers are employed to save time and produce sharper castings, free from "pin-holes." The castings are trimmed by means of air hammers, and many minor operations of assembly, grinding, drilling, reaming and hoisting are performed by pneumatic tools. The company has wisely adopted the policy of standardizing on a single make, and is using the "Little David" line.

The compressor equipment consists of two Ingersoll-Rand "Imperial" type XC3 machines, with compound steam ends and two-stage compression. They have a combined capacity of about 3,200 cubic feet of free air per minute, at 100 pounds pressure.

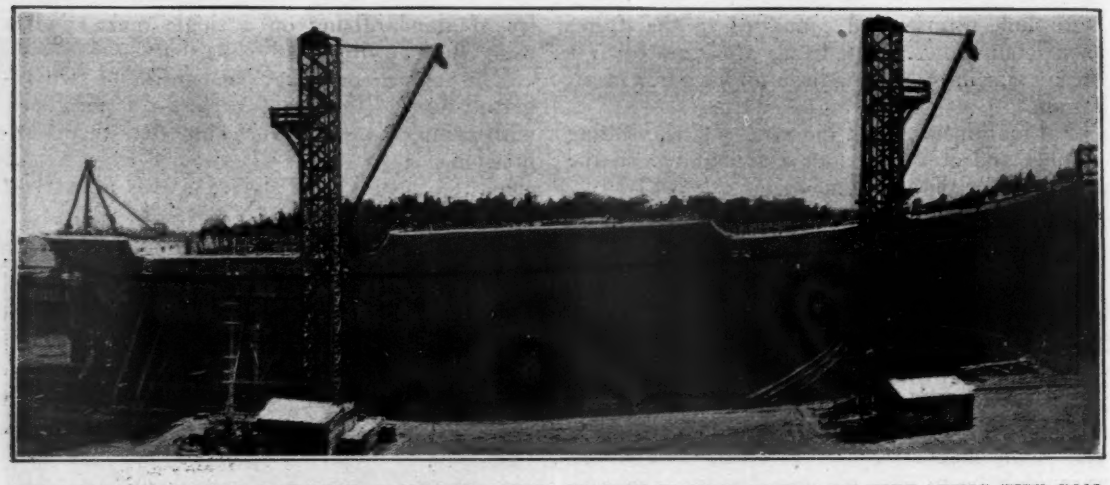


RAILROAD TYPE SHOVEL AT WORK.

Some of the care put into the making of Marion Shovels might at first thought seem unnecessary; the company maintains a large laboratory of tests and inspections to insure the perfection of every piece of raw material and completed part that goes into one of its steam shovels. But when we consider that the contractor often places great reliance on the ability of his shovel to stay at work, and save him time penalties; and that great numbers of shovels are located in the Phillipines, South America and other far-off places, where it would be extremely difficult to make repairs, we see the importance of making the steam shovel as perfect as possible. It is gratifying to note how extensively air tools are employed in the manufacture of this high-grade product.

An American Petroleum Institute has been formed with its headquarters in Washington. Its function will be to promote mutual coöperation between representatives of the industry and the departmental or legislative organizations of the Government.

The output of Japanese coal mines during the last seven years was, in tons, as follows: In 1912, 15,709,663; 1913; 17,050,267; 1914, 17,289,-861; 1915, 15,488,828; 1916, 17,476,803; 1917, 19,887,147, and 1918, 20,835,254.



THE *POLIAS*, SECOND LARGEST CONCRETE SHIP IN THE WORLD, BUILT BY VIBRATING THE CONCRETE FORMS WITH A PNEUMATIC HAMMER TO PERMIT OF A DRYER AND STRONGER MIXTURE OF CONCRETE.

The Concrete Ship "Polias" Launched

Pneumatic Hammers used to Settle Concrete Mixture by Vibrating the Forms

THE SECOND largest concrete ship in the world, the S. S. *Polias,* was launched on May 22 at the Fougner Yard, North Beach, Long Island, New York, by the Fougner Concrete Ship Building Company for the Concrete Ship Section of the United States Shipping Board. Through the courtesy of the Portland Cement Association of No. 347 Madison avenue, New York, we are glad to present to our readers a narrative of the building of the *Polias.* For the accompanying illustrations we are indebted to *Concrete Craft,* issued by the Concrete Ship Publishing Corporation, New York.

The vessel was constructed under the supervision of Mr. H. A. Hyman, General Superintendent of the Fougner yard, and of Mr. Walter R. Harper, engineer, Resident Representative of the concrete section of the Shipping Board. Mr. Joseph di Statio was the designing engineer. This craft has a length over all of 281 feet, 9 inches, a beam of 46 feet and a moulded depth of 26 feet, 6 inches. The *Polias* is second in size in the world as a concrete ship only to the *Faith,* launched a year earlier in San Francisco. In addition to these two there are now only three other concrete ships in existence: the *Atlantus,* launched last December, now undergoing trial; the *Palo Alto,* lately launched by the Shipping Board, and the *Armistice,* plying between Rotterdam and English ports.

The construction of the *Polias* was started in August, 1918, the first steps being to lay off on the mould loft floor at full size the water lines at intervals of 3 feet, and the fore and aft body plans with lines every 4 feet, or sections through the ship at each frame, which are 4 feet on centres. Moulds or templates were made from the body plans at each frame, from which the outside forms for the concrete were made to follow the true lines of the ship. Moulds for the inside forms are also made from the body plans.

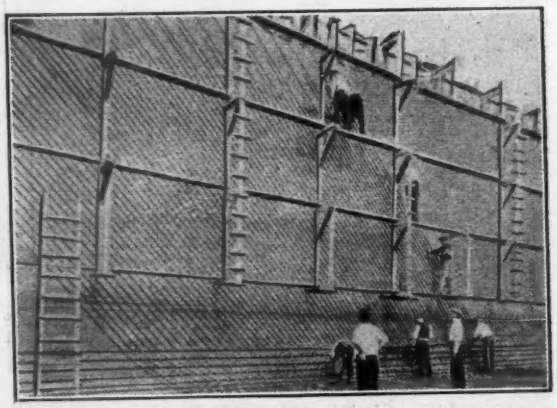


FIG. 1—NAILING STEEL REINFORCING BARS.

The reinforcing steel in the concrete shell is bent to conform to the lines of the ship from these templates. The outside forms of ⅞-inch dressed lumber make a complete wooden shell, having the shape of the ship, while the inside forms 5 inches away make a second wooden shell, or, in other words, we have two wooden shells. Between these two shells is placed the reinforcing steel which is installed before the inside forms are placed.

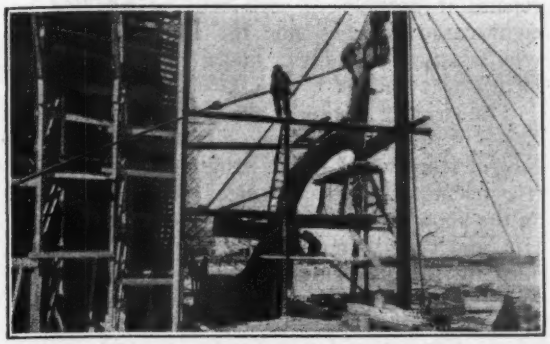


FIG. 2—PUTTING THE STERN FRAME INTO PLACE.

Into this space, between the two forms containing the reinforced steel, is poured the concrete, which hardens and takes the lines of the ship. The concrete could not be tamped on account of the intricate mass of steel, which consisted of four diagonal layers of steel ½ inch and ⅝ inch in size, 4 inches on centres.

To make the concrete dense and to settle it around the steel, small pneumatic hammers were used to vibrate the forms. The application of the hammer, a "Little David" made by the Ingersoll-Rand Company, is shown in an accompanying photograph, Fig. 4.

This was a new method of tamping concrete and was found to give excellent results. Vibrating the forms in this manner permitted the use of a rather dry mixture, and therefore the obtaining of a greater strength than could have been

FIG. 3—AT THE AGE OF ONE MONTH, BILGE AND SHELL STEEL WELL UNDER WAY.

obtained with a wet or sloppy mixture, which it would have been necessary to use in order that the concrete could thoroughly imbed all the steel.

The mixture for the concrete used is one part cement, two-thirds part sand, one and one-third part gravel, making a one-half mortar. Compression tests average 5,000 pounds per square inch, some tests running as high as 5,500 pounds per square inch. About 1,450 cubic yards of concrete and 525 tons of steel were used in the construction of the ship.

This was pioneer work, there being no previous work of this kind to refer to when the question of methods to be used came up. Consequently the engineers in charge were called upon to exercise a great deal of ingenuity and many new methods were tried out on various parts of the work.

The contractors were also handicapped in not having mechanics who had had previous experience in concrete ship building, as no concrete ships had been built in this vicinity, and only three

FIG. 4—VIBRATING THE FORMS WITH PNEUMATIC HAMMERS.

in any part of the country. It was not possible to obtain mechanics who had had previous experience on like concrete work. However, some of the men had worked on concrete barges, which is quite a hard type of construction. With perseverance on the part of the engineers in charge, very good results were obtained.

The concrete in the bottom and outside shell of the ship is 5 inches in thickness. The main deck has a thickness of 4½ inches, while the forecastle, poop and bridge decks are only 3 inches in thickness.

The ship is designed for carrying general cargo and merchandise, and its cargo holds are large and free from obstructions. The forward hold is considerably larger than the aft. There are four water tight bulkheads, one in forward part which forms the forward peak tank, one at each end of the engine room and boiler room, separating them from the fore and aft cargo holds, and one water tight bulkhead located aft, forming the aft peak tank. The fore and aft peak tanks are for water ballast, also a sea water ballast tank amidship under the engine room.

The machinery for propelling the *Polias* is located at midships. Two coal burning boilers of the water tube type, each containing 2,500 square feet of heating surface, will furnish steam for all

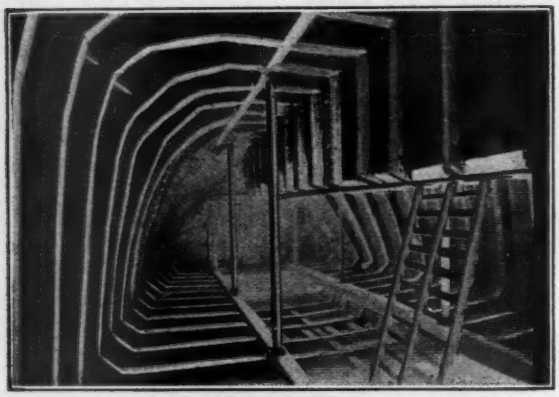


FIG. 5—INTERIOR OF THE HULL SHOWING RIBS AND SHAFT.

machinery. The main engine is a 1,400-horsepower triple expansion vertical marine, exhausting into condenser, which is common marine practice.

Reserve boiler feed water tanks constructed of concrete are located under engine and boiler room floor, thereby omitting the usual steel tanks, which are often located in aft cargo hold. This arrangement adds about 2,500 cubic feet of cargo space to aft cargo hold.

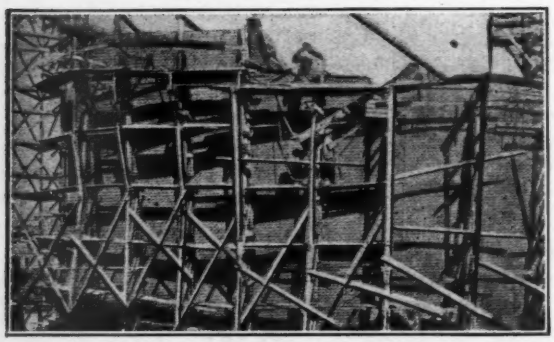


FIG. 6—FINISHING THE EXTERIOR WITH THE CEMENT GUN.

Electric current is supplied by a 15 K.W. generator, driven by a vertical engine. Refrigeration is supplied by a 1-ton ice machnie, which is located in the engine room starboardside.

The refrigerator room is located on the bridge deck just off the galley. All pump auxiliaries will be so connected that in case of a breakdown of any one pump, its functions will be performed by another pump and enable the crew to make repairs if possible. Cargo will be handled by eight cargo winches, one for each boom. The windlass is of the Hyde make, two cylinders, 7 inches by 7 inches.

The steering engine is also of the Hyde make, and is of design known as a quadrant type. The control from wheel house is by means of an electric telemotor. A hand steer is also provided on the poop deck to be used in case of emergency. Hot and cold water and shower baths are supplied for the quarters of officers and crew. The vessel is fitted throughout with modern sanitary plumbing.

The *Polias* is to be outfitted and will have her machinery installed at Providence, R. I. She will have her trial trip some time in the early part of the autumn.

The Bureau of Standards announces a continuation of a service available in its gage laboratories in Washington, New York and Cleveland, Ohio. In general two kinds of services are rendered. The first is advice and research by its technical staff, where the results are of general utility to American manufacturers; for such work no charge is made. Second, the routine testing of gages for manufacturers for which a charge is made according to the following schedule of fees: Plain plug gages, plain ring gages, snap gages, flat or round end standards or checks —50 cents each; measurement of any one element, such as lead, angle or diameter, of threaded plug gages—50 cents each; measurement of lead or angle of threaded ring gages—50 cents; complete measurements of thread gages—$1 each; photographs of form of thread of threaded plug or threaded ring gages—25 cents each; profile gages or fixtures (depending upon the complexity)—$1 up. All gages, instruments or tools submitted for test should be accompanied with drawings or specifications to which they are to conform; also complete information to the route of shipments of gages, nature of the test desired and disposal of the gages after test.

With a view of obtaining the enlistment of 15,000 men for the air service, literature is being circulated from 104 Broad street, New York City, by the Department of Air Service. Those desiring to become aviators, dirigible balloon pilots, chauffeurs, mechanics, or work at some one of the thirty other trades required in the air service, are invited to forward their names to the address mentioned.

A COMPRESSOR LUBRICATION SUGGESTION

By C. T. BAKER

The article by Mr. H. V. Conrad, page 9072, *et seq,* March issue of COMPRESSED AIR MAGAZINE, concerning the lubrication of air compressors, is excellent, and should be given serious consideration by the owners and operators of such machinery.

If I may add a suggestion in this connection, I would strongly advocate the use of a suitable oil separator to be placed on the discharge line between the air cylinder and air receiver, and so arranged as to permit the blowing out of the entrapped oil at regular intervals, say once each day.

An oil separator such as is used on the gas-discharge lines of ammonia compressors would meet the requirements.

By following this plan most of the oil passing from the air-compressor cylinders will be entrapped and prevented from getting over to the air receiver, and this oil when drawn off can usually be used to advantage somewhere about the plant if properly filtered.

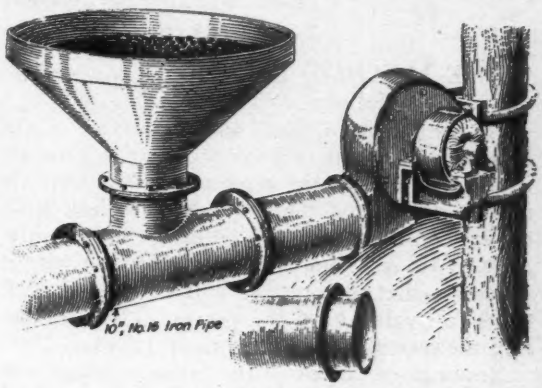
Another thing in this connection: It would help matters to place on the drain of the air receiver a suitable trap to automatically drain it of moisture and oil. This trap would, of course, be similar to the ordinary steam trap, except that its valves should be designed for the character of the work they are to perform. It should be by-passed, permitting hand draining of the receiver in case trap repairs are to be made.

In discussing the paper on lubrication, read before the Physical Society by Principal S. Skinner, C. T. Thomsen said that it had been found that among mineral oils the best lubricants were those with a large proportion of unsaturated hydrocarbons. It is thought that the more of these that are present the more intimately the oil will adhere to a metallic surface. Now, some of the animal and vegetable oils are very largely composed of unsaturated constituents, so that this property of adherence to metallic surfaces may readily be greater in these cases. He thought compressibility was of negligible importance.—*The Engineer.*

STORING COAL WITH A FAN

The illustration shows a method of handling coal for storage successfully employed by Mr. H. H. Finch and described by him in a recent issue of *Power.* For several years the coal for the use of the plant had been stored on a lot about 200 ft. square and a number of men were generally employed in wheeling it back.

This was slow and expensive, and to eliminate useless work, writes Mr. Finch, "I had some 10 in. pipe made from No. 16 iron joined together end to end, each end being flanged and fitted with a collar for the purpose of securing the lengths together so that they would not work



HOW BLOWER KEEPS FOUR MEN BUSY FEEDING THE HOPPER.

loose. The tee to which the hopper is secured is made of cast iron. An old blower did the business and it handled the coal faster than four men could find the hopper."

In order to keep the coal on the lot a back-stop was put up, but this did not stop the dust, so a hole was made about two feet from the discharge end of the pipe and a hose nozzle so inserted as to spray water against the air blast, which broke up the water into a fine mist and mixed it with the coal.

The pipe was about 70 ft. long in 10-ft. lengths. The blower is driven by a 25-hp. motor, and the coal is stacked from ten to twelve feet deep. It can be stored at a very low cost with this machine.

A new world's record in shaft sinking was obtained in December, 1918, at the Crown Mines, Johannesburg, South Africa. The shaft at which the record was made is circular, having a diameter of 20 ft. inside the walling, and during December was sunk 279 ft., or from a depth of 655 to 934 ft., the average speed being nine feet in 24 hours. The cost of sinking, exclusive of walling, was between £13 and £14 per ft. during the month.

The previous world's record was also held at the Crown Mines, where 252 ft. was made in a 31-day month at the No. 14 circular shaft of the mines; this was also a 20-ft. shaft. R. C. Warriner, 120 Broadway, New York, was consulting engineer at the Crown Mines up to the end of 1918.

Determination of Amount of Air Leakage

For a System of Pipes and Receivers the Volume of Which Cannot Easily be Measured

By P. H. TROUT, JR.

(Associate of American Institute of Electrical Engineers, Roanoke, Va.)

(Copyright, 1919, by Compressed Air Magazine Co.)

THE METHOD followed in this undertaking is as follows:

At the luncheon hour, one compressor is run long enough (until 12:2:0) to insure that no air is being utilized at the beginning of the test. It is then cut off and the air allowed to leak from the system, thus gradually reducing the pressure. At 12:20:0 one compressor of known capacity is started so that the pressure will be brought back to its full value (100 lbs. per sq. in. gauge) before the men again begin work at 12:30:0.

Readings are taken of the pressure gauge and times and plotted in two curves. The amount of the leakage is calculated from these curves.

As a check on the calculations and the method, the volume of the system was figured from the curves and compared with the best approximation of the actual volume as obtained by measuring the receivers and estimating the pipes.

It is assumed that the condition of the system as to leakage remains unchanged during the test. Also that the compressor is delivering its full rated capacity (1562 cu. ft. free air per min.) just before the regulator or unloader operates (12:26:0, Point E of the curve). These assumptions can usually be checked and verified in each case.

CALCULATIONS

Let t equal *times*

p′ equal pressures while the system is leaking only

p″ equal pressures while the system is being filled, the leaks remaining the same.

At the point A we have $\frac{dp'}{dt}$ equals 8.75

At the point E we have $\frac{dp''}{dt}$ equals 10.62

Total..... 19.37 which is the rate at which the pressure would have risen had there been no leakage. If, at the point E, the compressor is furnishing 1526 cu. ft. of free air per min. to the system, then the *leakage* amounts to $\frac{8.75}{19.37}$ times 1562, equals 705.6 cu. ft. of free air per min., leaving 856.4 cu. ft. of free air per min. to go towards filling the system.

On the tangent FE this would raise the pressure from 0 to 101 lbs. guage in nine minutes and thirty-six seconds (12:26:0: less 12:16:24:) in which time 9.6 times 856.4 equal 8239.4 cu. ft. of free air would have been delivered to the system, over and above the leakage. This is equivalent to a volume of 1066 cu. ft. which is the *volume* as calculated from the curves.

$$\frac{101 \text{ plus } 15}{15} \text{ equals } 7.73 \qquad \frac{856.4 \text{ times } 9.6}{7.73} \text{ equals } 1066.$$

RESULTS

Date.	Leakage in cu. ft. of free air per min.	Volume as calculated from curves.
5-2-19	1013	1098
5-5	997	1231
5-6	777	1267
	Repair work stopped	
5-7	960	1074
5-8	1095	1099
	Heavy repairs	
5-15	706	1066
	Average	1139

Which is to be compared with

Volume of receivers, measured.....	705
Volumes of 5″ 6″ and 7″ mains, estimated.	285
Volumes of 2″ 1″ ¾″ and ½ inch pipes and hose guess	100
	1090

REMARKS

The method does not interfere with the regular operation of the system, nor does the plant have to run overtime.

It does not require special instruments.

It gives results based on actual operative conditions.

Any intelligent station engineer or repair foreman can compare two curves and see that the gauge falls lower on one day than another, while on the other hand, the plant superintendent can form a very fair idea of the cost of the leakage and of how much he can afford to spend on pipe line maintenance.

Repairs were made from May 1st until May 12th and then on account of other work were dis-

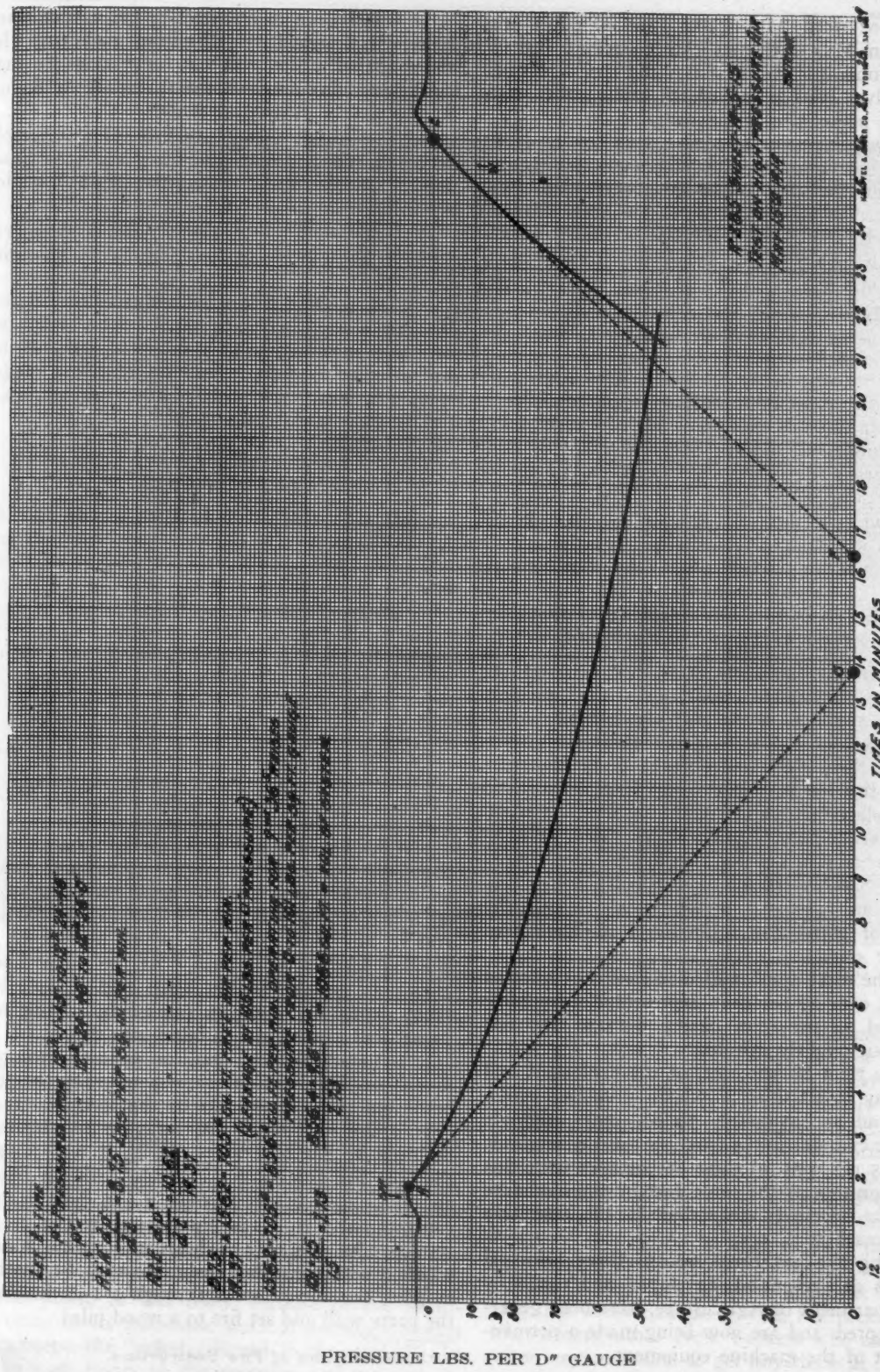


Chart showing test by Mr. Trout on high pressure air, May 15, 1919.

THIS CHART WILL BE SELF-EXPLANATORY TO ENGINEERS IN CONNECTION WITH MR. TROUT'S ACCOMPANYING ARTICLE ON DETERMINATION OF AMOUNT OF AIR LEAKAGE.

continued until May 12th. Special effort was made on May 14th and 15th to reduce leakage to a minimum. Repair parts and special fittings and valves have been ordered and further tests will be made after their installation.

Knowing the cost of compressing one cu. ft. of free air per min. and the number of hours that the plant runs, the cost of the leakage can easily be figured. Allowance should be made for the air which is in the system when it is shut down.

Simultaneous values from the leakage curve can be substituted in the general equation of a conic section

$(m\text{-}x)^2$ plus $(n\text{-}y)^2$ equals e^2 (y sin a plus x cos a-d)^2

and the values of m,n,e,a and d determined.

The curve would probably be found to be a hyperbola with its axis at 45 degrees to the present co-ordinates, and the law governing the flow of air from the average orifice found in actual practice would be known and would probably be found to follow the law of the flow of air through a long thin pipe, rather than the law of flow through a standard orifice in a thin plate.

DUST EXPLOSIONS AND FIRES IN THRESHING MACHINES

Numerous explosions and fires in threshing machines have been reported in the last few years in the large grain growing sections; probably many more than would commonly be supposed. Since 1914 more than 700 have occurred in the Pacific Northwest alone, about 300 taking place in 1914 and almost as many in 1915. To determine the causes of these fires and explosions, and to develop methods of prevention, the U. S. Department of Agriculture has conducted an extensive investigation, during the course of which the following facts have been brought out:

Of the total number of machines thus affected in 1915 over 27 per cent. represented a complete loss, and 34 per cent. partial damage, the rest being but slightly affected.

More than 80 per cent. of the explosions and fires may be classified as wheat smut dust explosions, and approximately 76 per cent. originate near the cylinder in the front part of the machine. Over 75 per cent. of these occurrences were due to the ignition of the smut dust by the discharge of static electricity generated by the operation of the machine.

During the last three seasons three principal methods of prevention, developed and tested by the Department of Agriculture, have been generally adopted, and are now being made a permanent part of the machine equipment.

1. Installation of an effective fire extinguisher especially designed for threshing machines. In the event of a fire, this not only saves the machine, but also prevents the spreading of flames to the nearby grain and straw.

2. The installation of an exhaust fan to collect and remove smut and dust from the separator, thus preventing the formation of an explosive mixture of dusts.

3. Installation of an effective grounding system for the removal of static electricity from the machine.

The field men of the Department have found that machines properly equipped in this way have not experienced explosions and fires, while those not so equipped have suffered extensive damage, with destruction also to the surrounding grain.

HOW HOT AIR SPREADS FIRES

*BY IRA H. WOOLSON**

Although the hallway floors of a building may be of tile or marble and the stairways built entirely of marble, stone or metal, with no combustible material about them, they are nevertheless a serious fire hazard, because they act as flues to carry the hot products of combustion from a fire in one part of a building to another where combustible material is present. The danger of this method of fire transmission is little appreciated by those who have not studied it.

When air is heated to 1000° F. or over—which is a temperature quickly reached in most fires—it will ignite instantly everything combustible with which it comes in contact. The actual flames of a fire may extend only a few feet from the point of origin, but the hot smoke and invisible heat waves may easily travel through an incombustible stairway or hallway for 50 or 100 ft. and then ignite the whole surface of a wooden door in an instant. At the same time, glass door panels and fan lights will collapse by rapid expansion, and the intense heat entering rooms will cause them to burst into flames.

It is surprising how small an opening through a wall or floor will suffice as a gateway for superheated air to start a fire on the opposite side.

In a fire in a reinforced concrete investigated building at Far Rockaway, L. I., it was found that the fire entered the concrete building from an adjoining structure through a 4-in. hole in the concrete party wall, and then passed to two stories above by way of 2-in. holes in concrete floors where a heater pipe had been removed. At another place the hot air went through a 1-in. hole in the party wall and set fire to a wood pile!

**National Board of Fire Underwriters.*

The Biggest Engine in the World

(Illustrated with copyrighted photographs by Underwood & Underwood, N. Y.)

FIG. 1—THE BIGGEST ENGINE IN THE WORLD, IN CENTRAL FOREGROUND, HOUSED IN THE WORLD'S BIGGEST POWER HOUSE. GENERAL VIEW.

WE ARE fortunate in being able to present to COMPRESSED AIR MAGAZINE readers in this issue the accompanying photographs showing the biggest steam engine in the world, housed in the world's largest power house, that of the Interborough Rapid Transit Company of New York, in East Seventy-fourth street. Here is generated power for the driving of the fast electric trains of the elevated, subway and surface lines of Manhattan, Brooklyn and the Bronx.

The Interborough is known as the greatest passenger-carrying railroad in the world and it is also proud to call itself, because of the multiplicity of its automatic devices and their results in usage, the "safest railroad in the world." In the rush hours of the morning and evening its ten-car steel trains roar through tunnels underneath the streets of New York at fifty miles an hour, each train hauling close to 2,000 persons, and running at times less than a minute apart.

The operation of the Interborough's great Subway system is regarded by transportation experts as a marvel of speed and efficiency, despite the handicap of crowds of passengers so great, and always growing, that it seems as though the company will never be able to keep pace with the increase in New York's population.

New Yorkers are prone to growl at the Subway, not because of the service, but because there are so many other New Yorkers who use it, but when anyone wants to get anywhere in Manhattan in a hurry, he takes the Subway. Every

FIG. 2—THE OLD AND THE NEW. THE BIG ENGINE AT THE LEFT OF PICTURE IS OF 7,500 H. P. BEYOND IS THE BROBDIGNAGIAN 100,000 H. P. ENGINE.

hour of every day in the year its trains catapult the millions of the world's metropolis to and from business, to social affairs, the theatre, to weddings and funerals.

At three or four o'clock in the morning, to the amazement of visitors in New York, the trains seem to be as filled with hurrying people as in the daylight hours. It is considerable of a railroad that takes in one hundred thousand dollars a day in nickels. Incidentally one can ride all day in the Subway for a nickel if he wants to —but who wants to?—and can ride on a continuous trip of about thirty miles for a nickel, a reasonable enough cost for transportation.

Prior to the advent of prohibition upon these arid shores gentlemen were known to have ridden back and forth over the lines of the system several times in the small hours of the morning, before being sent on their way refreshed (from slumber) and rejoicing, by some kind-hearted guard. Who says the great corporations are soulless?

Our present concern is with only one of the Interborough company's power houses, a general view of which is to be noted in Fig. 1. In the foreground are to be seen the new steam turbines recently installed. The first is a 40,000 h.p. Westinghouse double compound turbine. Next beyond it is the largest engine in the world, the 100,000 h.p. Westinghouse triple compound turbine, the generators run by this engine being connected with the three air stacks. Further on in the picture are six 7,500 h.p. reciprocating engines with generators about thirty feet in diameter.

One of the old engines would weigh about as much as the triplex, which is more than twice as powerful as all six of the old engines. The

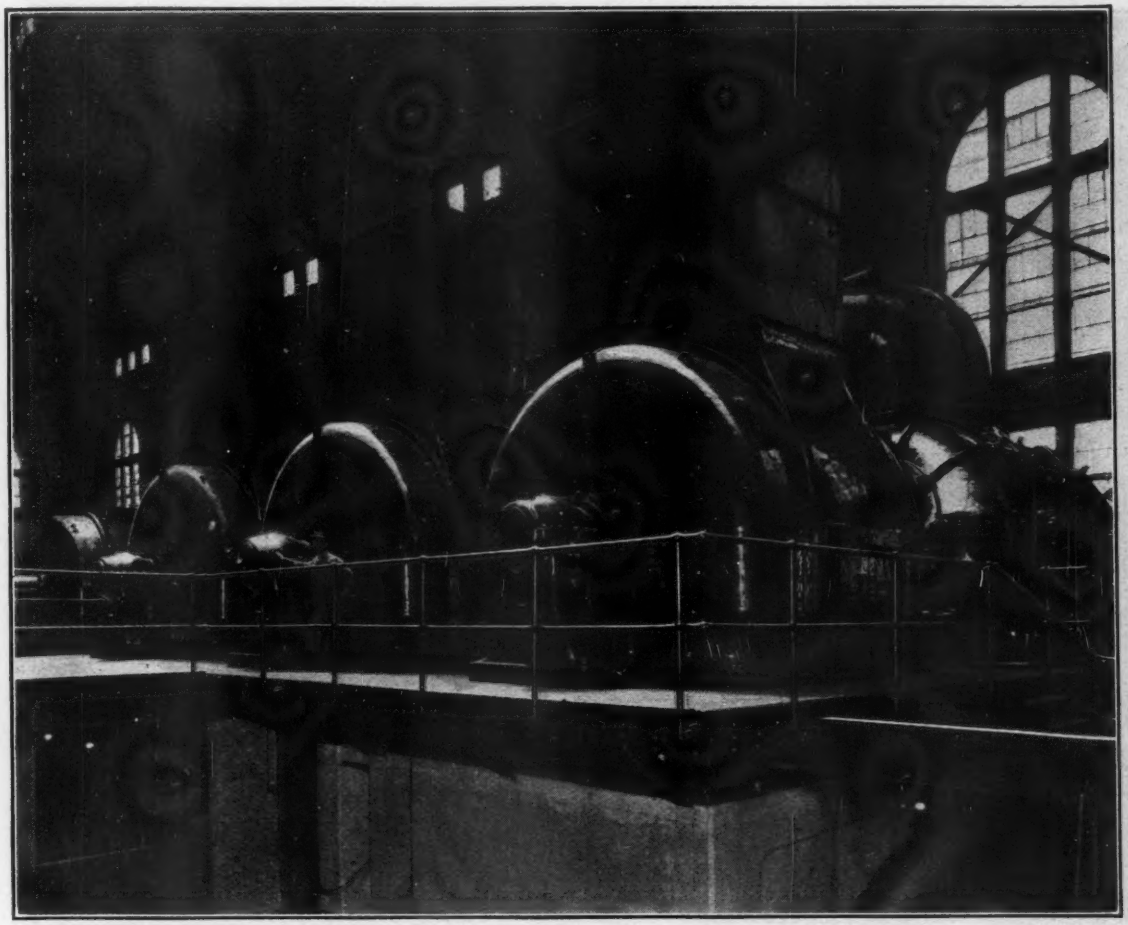


FIG. 3—THE THREE ELECTRICAL GENERATORS DRIVEN BY THE 100,000 H. P. STEAM TURBINE COLOSSUS. WASHED AND FILTERED AIR ESCAPES CONTINUOUSLY THROUGH THESE GENERATORS AND PASSES OUT THROUGH THE BIG STACKS. THESE GENERATORS ARE EACH AT 20,000 KILOWATTS CONTINUOUSLY AND AT 23,500 KW FOR TWO HOURS A DAY.

100,000 h.p. engine will alone generate enough electrical energy to run nearly half of the transportation lines of Manhattan.

The great turbine, a near view of which is seen in Fig. 5, consists of one high-pressure and two low-pressure elements, each connected to a separate electric generator. This gives it the appearance of three distinct machines, but it is actually a single unit and all three elements are started and controlled as one. The triple arrangement is employed because it is mechanically superior to the single element design for a machine of such great power. There is also a great advantage that in an emergency any one or two of the elements can be shut down without stopping the others.

This wonderful engine is far less spectacular in appearance than the old 7,500 horse power engines in the same room, but it has a massiveness that bespeaks tremendous power within.

The difference in size is due to operating principles. The reciprocating engine consists mainly of a cylinder in which the piston is pushed up and down by steam. The main parts of the turbine, on the other hand are a spindle, carrying hundreds of small vanes, and a casing which encloses the spindle. The steam, acting upon the vanes of the spindle, revolves it as the wind revolves a windmill.

The motion of the turbine is rotary and as there are no heavy parts to be stopped and started at the end of every stroke as in a reciprocating engine, very high speeds are permissible, thus making it possible to develop great power from

FIG. 4—GOVERNORS AND CONTROLLING MECHANISM OF THE GIANT ENGINE. THE GOVERNORS CONTROL AUTOMATICALLY THE OUTPUT OF THE MACHINE AND PREVENT OVER-SPEEDING. NOTE THE LOFTY CEILING OF POWER HOUSE AS INDICATED BY THIS PICTURE.

a comparatively small machine. The speed of this 100,000 horse power turbine is 1500 revolutions a minute.

Superheated steam enters the high pressure element at 205 lbs. pressure and, dividing into two portions, is exhausted into low-pressure elements of 15 pounds pressure. From the low pressure elements it goes into the condensers in which a 29-inch vacuum is maintained. Eight hundred and twenty-six thousand pounds of steam are used per hour for a maximum load, and the water rate is below 11 pounds of steam per kilowatt hour. The generators, as noted in Fig. 3, are each rated at 20,000 kilowatts continuously and at 23,500 kw. for two hours. Three-phase, 25-cycle current at 11,000 volts is delivered to the substations. The floor space covered by the big turbine is 52x50 ft. Its height is about 20 ft.

LARGE CONCRETE PIPES FOR WATER, GAS AND AIR

One of the most suggestive and significant signs of the times in the engineering field is the recent decision of the Birmingham (Eng.) authorities to use concrete pipes for their water main 35 miles long and 5 feet in diameter. The fact that Birmingham is a great center of the iron and steel industry makes this decision the more surprising. It seems more than probable that this example will be followed by other municipalities, and that concrete piping will be coming into extensive use not only for water but also for gas and compressed air.

We note a plane but paradoxical truth about the airplane to the effect that it is not much good unless it is used up.

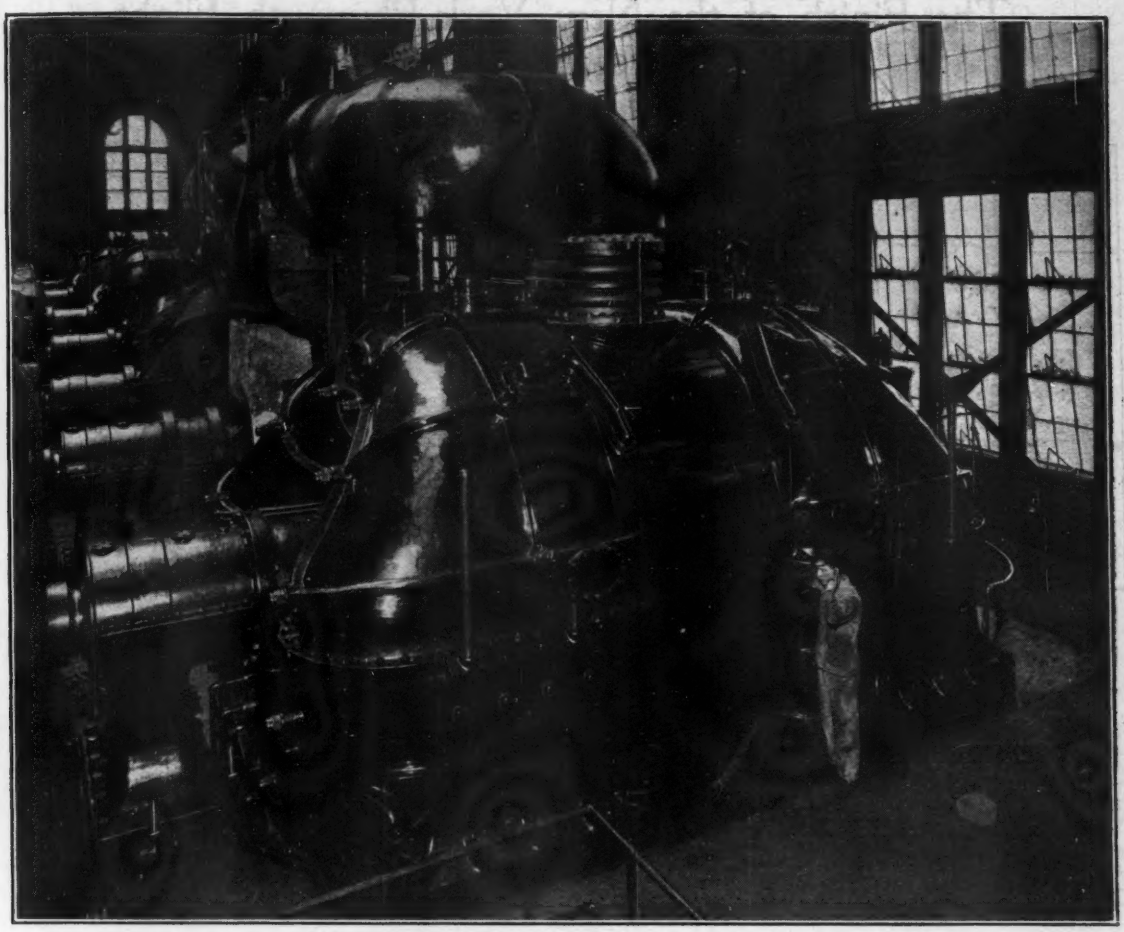


FIG. 5—A "CLOSE UP" VIEW OF THE 100,000 H. P. E LECTRICITY-GENERATING MONSTER. SEE TEXT FOR DETAILS.

DEFECTIVE HOSE COUPLINGS

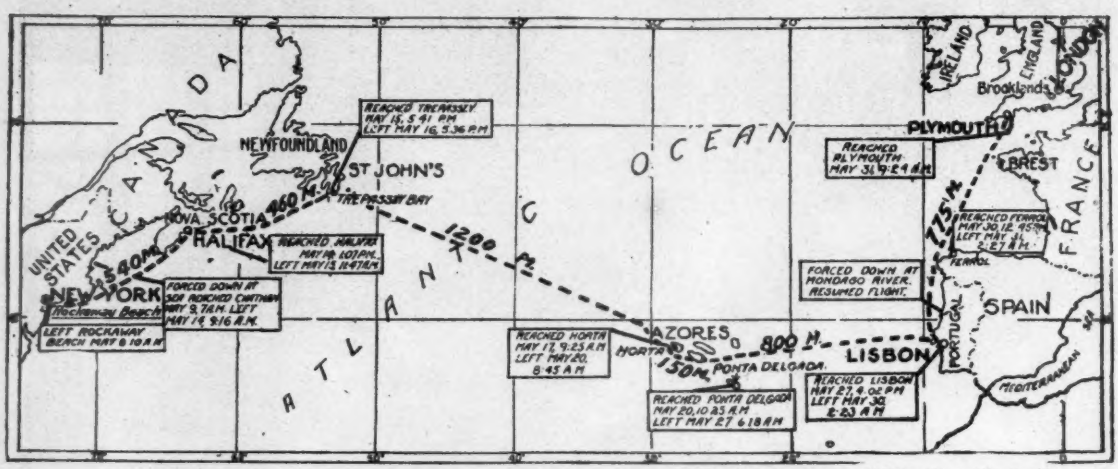
At the recent annual meeting in Chicago of the Air Brake Association, a paper on Air Leakage and Money Wasted, etc., called attention to the fuel waste due to brake pipe and leakage. It was stated that examination of 1,000 freight cars showed that 35 per cent. of the leakage existed in the hose couplings. Further investigation developed that it was difficult to find couplings in service that would pass the M. C. B. standard coupling gage test. Employees often use makeshifts to secure tight joints, and at least one road has adopted a special gasket to eliminate hose coupling leakage. Some special types of gaskets submitted to railroads for approval when tested have required from 1,000 to 1,300 lb. to pull the hose apart. Such excessive strains fracture the hose and cause the brake pipe to shift, resulting in leakage. The paper recommended that the universal practice of gaging air brake hose couplings be included when periodic attention to air brake equipment is being given freight cars in shops or on repair tracks.

Emil Swensson, one of the pioneer designers to whom is accredited the success of the steel hopper car, died in Pittsburgh recently. His first work on coming to the United States in 1881 was on the construction of the old Hudson River railroad tunnel. The following year he became topographer and assistant engineer for the South Pennsylvania R. R., now a part of the Pennsylvania system. Shortly thereafter he became identified with the bridge building industry of Pittsburgh, continuing in that and related lines in an official capacity for many years.

The Finish of the New York-Plymouth Flight

A Climax of 20th Century Transatlantic Feats

By HAVELOCK C. HISLOP



(Map by courtesy of *The New York Times.*)

THE AERIAL ROUTE OF THE NC-4 ON HER MEMORABLE TRANSATLANTIC JOURNEY.

JUST AS WE all felt certain he would, Lieutenant Commander Read of the United States Navy, completed on May 31 the last legs of his epoch-marking aerial journey from New York to Plymouth, England, by successfully negotiating the trip from the Azores to Portugal and thence to the port from which the Pilgrim Fathers sallied forth for America early in the seventeenth century. He won the plaudits of the world and was showered with honors in Lisbon, Plymouth, London and Paris, as were the men of his gallant crew.

Read took premier honors as the first transatlantic aerial navigator, but his fine feat was quickly followed by the non-official achievement of Captain John Alcock, pilot, and Lieutenant Arthur W. Brown, his American navigator, who flew in a Vickers-Vimy biplane from Newfoundland to Clifden, Ireland, in a non-stop flight of sixteen hours and twelve minutes, landing June 15. Alcock and Brown flew through dense fog most of their journey, and for many hours saw nothing of sun, moon or stars. They found themselves unwittingly looping the loop, flying upside down only ten feet above the water, and for four hours the machine was covered by a sheet of ice, caused by frozen sleet.

Captain Alcock flew at two miles a minute, without accident, rising at times to a height of 11,000 feet. Brown's skilful navigation of the machine, in bringing it near to the center of the Irish Coast line, was a fine feature of the flight. Landing in a bog near the Clifden wireless station, Brown was dazed and temporarily deafened Alcock. Only two-thirds of the fuel supply was used. Captain Alcock declared, as a result of his flight, that the flying boat was the solution of transatlantic aerial travel, a reasonable deduction. To return to consideration of Commander Read's exploit:

The entry of the NC-4 into Plymouth was described as magnificent. Nothing could surpass the grace of her high, steady flight as she flew around the harbor before coming to rest like a gull on the surface of the water. Her men were welcomed by Plymouth's mayor at the Barbican, the very spot from which had set sail the historic *Mayflower* three centuries before. Kings, premiers and presidents vied with one another in doing honor to the pioneer aerial navigators of the Atlantic. President Wilson wired his congratulations and later received Commander Read at Paris. Portugal decorated the aviators with the Grand Cross of the Order of the Tower and Sword, over all of which the Navy Department and the American people were happy and proud.

Generous praise was accorded the Americans by the sportsmanlike British press, which had naturally been hoping that Hawker and Grieve would make the riffle. The safe arrival of the latter pair, after their unfortunate experience on their attempt at a direct crossing in their small land plane, and following a week of anxiety during which there was despair for their safety, was the signal for a great British demonstration in honor of their daring and courage, but which

did not prevent the English people from giving voice to such expressions as the following, which appeared in the London *Observer:*

"The romantic appeal of Hawker's desperate attempt somewhat overshadowed the businesslike success of Commander Read. The very certainty and regularity of the American flight have impaired popular appreciation of its true worth as a scientific achievement, and as an example of the irrepressible spirit of venturesome humanity.

"The flight is a tribute to the quality of the machine and the efficiency of an organization, but above all to the courage, endurance and skill of the pilot.

"America wins the first honors upon the transatlantic airways. Commander Read's arrival gives us opportunity for enthusiastic acknowledgment of the service that he and his country have rendered to the Old World and the New in first linking them up by air."

One of the pilots of the NC-4, Lieut. Commander Walter Sinton, described the last part of the long journey by air.

"We came down at the Mondega River," he said, "because we had a leak in a water jacket and were afraid it was a leak in the oil tank. In itself it was of little importance, but if it had been in the oil tank it would have been impossible for us to continue the flight. Our only reason for delaying overnight was the impossibility of rising from the river we landed in until the tide flowed in again.

"We left Ferrol next morning and had favorable conditions until off Brest. There we ran into fog, and had to come down sometimes to only 50 feet altitude to find our way. Generally we were flying at 1,500 feet, but sometimes went up to 2,000."

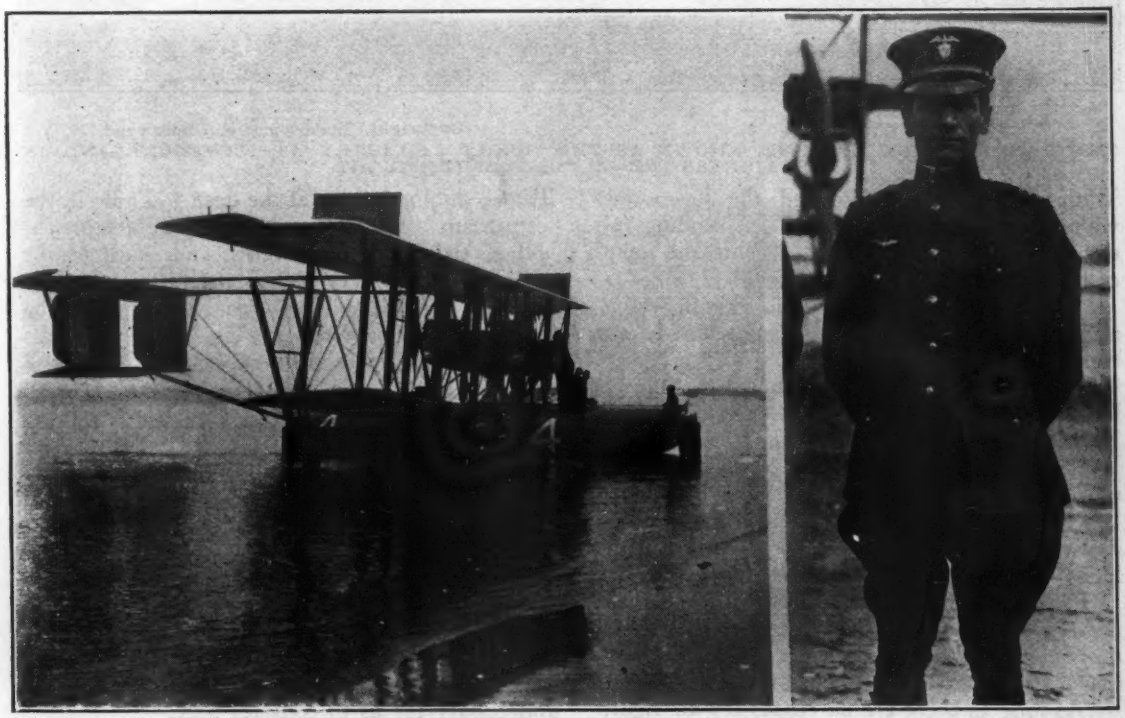
The visit to Brest was somewhat unexpected there, as it meant a slight detour. It gave rise to an interchange of messages between Commander Read and the American Admiral. Then Read wirelessed by way of the George Washington:

"Greetings from NC-4. I am sorry I cannot stop."

The Admiral replied by the same route:

"Congratulations on your magnificent flight. Sorry you cannot stop and let us entertain you. Good luck."

The passage had been so smooth from the Azores to Lisbon that the crew actually had a comfortable shave in the final hour. Only the start had been difficult—difficult and anxious.



(Copyright, Underwood & Underwood, N. Y.)

THE WORLD-FAMOUS NC-4 AND HER SKIPPER, LIEUTENANT COMMANDER ALBERT C. READ.

(Copyright, Underwood & Underwood, N. Y.)

THE HANDLEY-PAGE MACHINE, KNOWN AS THE "BERLIN BOMBER," AT NEWFOUNDLAND IN READINESS FOR TRANSATLANTIC FLIGHT.

With vexation they described the seven days' wait for the wind to fall that was sending rollers ten to fifteen feet high right into the mouth of the tiny harbor of Ponta Delgada.

"There was no room to rise in smooth water," said Commander Read. "We simply had to wait for a calm or buck those rollers."

In point of fact, they did the latter. The sea had fallen slightly, but it was still dangerously high. But they could bear it no longer.

"We just gave her a run and pulled her nose up," said Pilot Sinton, "and she rose like a bird. It was right at the harbor mouth, and believe me, it was rocky there among those waves. But our luck held all right, and after that it was easy."

Though the sky was cloudless, a haze had prevented them from seeing the patrol boats until they were almost atop of them, but nevertheless they hardly varied a jot from their course.

"As long as there are no clouds it's all right," said Commander Read. "You can just sit still and let her go. The first European land we sighted was the sandbanks off the mouth of the Tagus, shining golden at the dead low tide in the setting sun. Then we met the Portuguese planes, and picked up the hills north and south of the river, then the river mouth itself, and the city and the steam cloud between the masts of the *Rochester* and the *Shawmut's* searchlights."

The airmen complained of deafness as the result of the ten hours' thundering of the motors. They were not tired, they said—although more than one face looked haggard under its tan—but they were hungry.

"We ate some chocolate and sandwiches during the trip," said one, "but will be glad of a square meal."

They got their square meal and a good sleep and then followed preparations for a final getaway to England. The newspapers have been filled with pages of descriptive matter on the other popular aspects of the flight, which it is unnecessary for us to consider here.

The NC-4 in its flight from Rockaway to Plymouth covered a distance of 3,925 nautical miles in 57 hours and 16 minutes of actual flying

time. This represented 3,436 minutes of actual flying time, or an average speed of 68.40 knots an hour. The best average speed and performance over a sustained distance was the complete ocean flight of 2,150 miles from Trepassey to Lisbon, which was made in 26 hours and 47 minutes, and represented an average speed of 80.8 knots an hour. The general flight record of the NC-4 in detail follows:

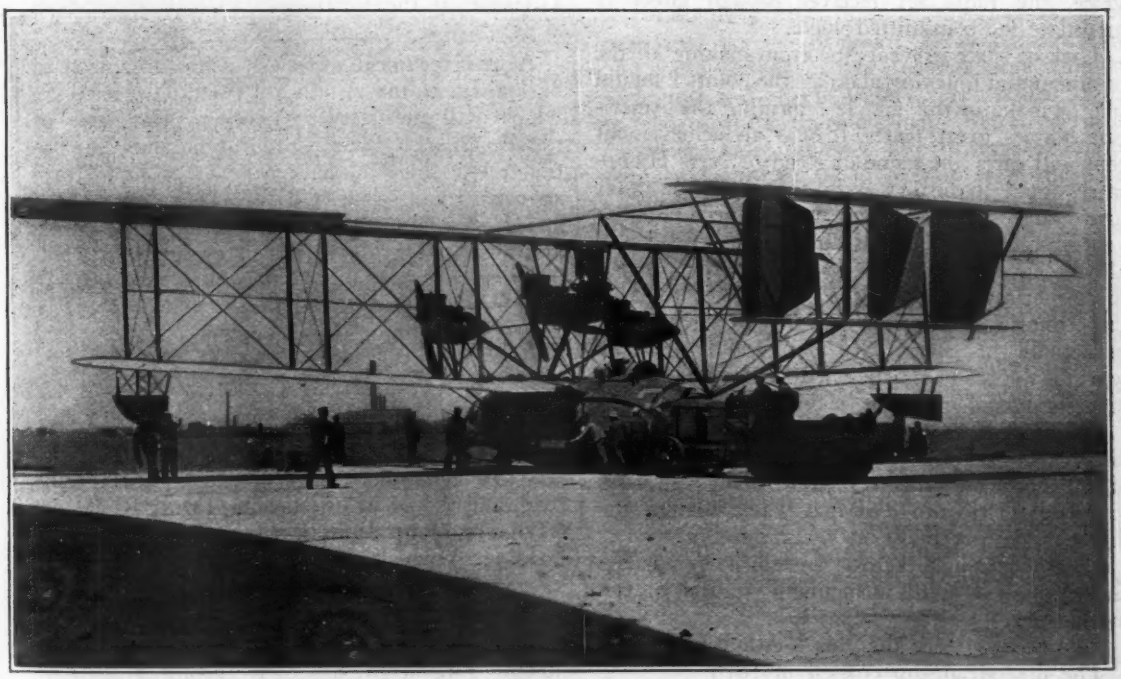
Course.	Date.	Naut. Miles.	Time.	Speed Knots.
Rockaway - Chatham (forced landing about 100 miles off Chatham)	May 8	300	5:45	52.0
Chatham - Halifax	May 14	320	3:51	85.0
Halifax-Trepassey	May 15	460	6:20	72.6
Trepassey-Horta	May 16-17	1,200	15:18	78.4
Horta-Ponta Delgada	May 20	150	1:45	86.7
Ponta Delgada-Lisbon	May 27	800	9:44	88.1
Lisbon-Mondego River	May 30	100	2:07	48.8
Mondego River-Ferrol	May 30	220	4:37	45.6
Ferrol-Plymouth	May 31	455	6:59	64.8
COMPLETE FLIGHT ROCKAWAY TO PLYMOUTH				
Rockaway to Plymouth	May 8-31	3,925	57:16	68.4
COMPLETE OCEAN FLIGHT				
Trepassey to Lisbon	May 16-27	2,150	26:47	80.3

A feature of the apparatus with which the NC seaplanes were equipped for safety and communication, and which I was unable to consider in my article of the June issue of COMPRESSED AIR MAGAZINE, was the wireless. Communication by wireless from an airplane, to me, is one of the most wonderful things in a wonderful world, and my interest is not that of a layman, either, for I was for years in the wireless telegraph business with what was at one time the greatest American radio company.

The radio on the NC planes involve two transmitters, we learn from the Navy authorities. One is a one-half kilowatt spark transmitter, the main element of which is a streamline generator and accessory apparatus which is driven by an air propeller and is mounted on the deck of the boat aft. This set weighs only forty-five pounds, but is used for the regular telegraph communication between the seaplanes and stations up to a distance of 250 nautical miles. Since this set is driven by a propeller, it can only be used while seaplanes are in flight.

The antenna used for this set is a single trailing wire leading from the tail of the boat for a distance of 250 feet down and to the rear.

A streamline lead weight holds the lower end of the wire down. With this transmitter it was possible for the commanding officer to send messages from time to time regarding the progress of the flight, to be retransmitted by the nearest shore station to the Navy Department at Washington. Also communication could be held with



(Copyright, Keystone Photo News, N. Y.)

TRACTOR USED FOR LAUNCHING AN NC TYPE SEAPLANE. THIS VIEW SHOWS THE NC-3, WHICH WAS CONSIDERABLY DAMAGED IN THE HEAVY SEAS WHEN IT ALIGHTED ON THE WATER NEAR THE AZORES IN A FOG, BUT CAME INTO THE HARBOR UNDER ITS OWN POWER BY "TAXI-ING" ON THE SURFACE.

destroyers and other craft and compass signals or other information requested.

The other transmitter is a combined telephone and telegraph transmitter, and operates on a small 12-volt storage battery. It is used on antenna consisting of wires permanently stretched on the skid fins on the upper planes so that it may be used while the seaplane is in flight or on the water.

It is this set which was used for telephoning between the three planes which flew to the Azores, arrangements having been made so that either the radio operators or the commanding officers themselves might communicate directly by telephone while the planes were in flight. Such interplane telephoning may be carried on up to a distance of twenty miles. While on the water this set may be used for telegraphing or telephoning a distance of about thirty miles.

A special feature of the telephone set is the anti-noise microphone, which is so constructed that the engine noises are not heard. This is accomplished by having the back of the microphone open. The exterior sound waves strike the back as hard as the face of the diaphragm, and therefore the effect is neutralized. The voice waves strike only the face of the diaphragm, and even though the operator cannot hear his own voice, the radio set receives enough effect to modulate the transmitted wave.

Lack of space prevents me from making all the comment and touching upon all the points I should like to make in this article regarding the American Navy's great feat. It was an achievement that will carry the name of Read of New Hampshire down in history with the names of other brave and steadfast men who gained fame as venturesome pioneers and discoverers. Read will always have an honored position on the rolls of the American Navy as the first officer to cross the Atlantic in a ship of the air, and science will perpetuate his name, without doubt, for the world is the richer for the scientific data he and his mates gathered on their celebrated journey.

Read's was another feat that made Transatlantic history. His trip was a climax to a book of human achievements it took many centuries to write. Eric the Red may have written the first chapter nearly 1,000 years ago.

Columbus sailed across the unchartered Atlantic in 1492 with incalculable results to the world.

Cabot first crossed the North Atlantic in 1497.

The first steamship crossed in 1819.

The first cable was laid in 1858.

But the twentieth century begins with four great exploits, constituting scientific strides that outstrip all previous achievements:

The first wireless message was flashed across the Atlantic in 1901.

The first submarine crossed the Atlantic in 1916.

The first wireless telephone spoke across the Atlantic in 1919.

The first Transatlantic flight was made in 1919.

We live in an age of wonders of air, land and sea.

The Chicago Pneumatic Tool Co. has announced the appointment of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Co., Ltd., whose offices are at 170 Piccadilly, London, and whose plant is in Fraserburg, Scotland. Mr. Goodhue will also be in charge of European sales for the Chicago Pneumatic Tool Co. Mr. Goodhue was for a number of years connected with the sales department of the Midvale Steel Co. and Midvale Steel & Ordnance Co. in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the Government. From that time until Jan. 1, 1919, when he became connected with the Chicago Pneumatic Tool Co., he was assistant manager of the steel and raw material section, Production Division, of the Emergency Fleet Comporation.

A new technical society is being organized to be known as the American Welding Society in which will merge the Welding Committee of the Emergency Fleet Corporation and the National Welding Council. Its purpose is to form an organization that will become a disinterested and dependable form of information on welding, and serve the interests both of the users of welding apparatus and the manufacturers of such apparatus and welding supplies. The address is, American Welding Society, 33 West 39th street, New York City.

Charles S. Cunningham, a member of the Michigan Railroad Commission since 1913, who was formerly connected with the Wabash Railroad, and then with the Grand Trunk R. R., after its reorganization in 1896, died recently at Lansing, Mich.

Prof, William H. Dorsey, head instructor of foundry practice at Carnegie Institute of Technology, Pittsburgh, has been appointed assistant in the training method section of the United States training service. This service is under the Department of Labor. Mr. Dorsey is a native of Sheboygan, Wis.

Survey of the Technical Field

Edited by FRANK RICHARDS

Application of the Sand Blast

*By H. D. GATES**

FOR THE average jobbing foundry, where the work runs promiscuously from small to large and the daily output is not large enough to permit of specialized equipment, no type of machine so effectually accommodates itself to all kinds of work as the high-pressure hose sand-blast.

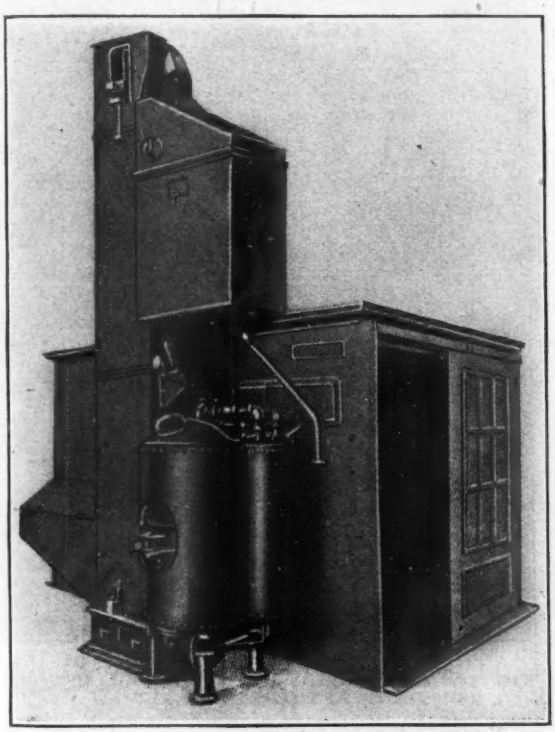


FIG. 1—MECHANICAL AND EXHAUST SCREEN SEPARATOR PERMITS REUSE OF WARMED AIR.

The hose type machine was the first method of application of sand-blasting, and consists of a sealed container into which the sand or other abrasive is loaded, and by direct air pressure driven through a hose of required length, the air and abrasive being discharged in combination through the opening of a small nozzle. As no expansion of the air takes place before discharge at the nozzle, the greatest velocity of the abrasive is obtained by this method, with corresponding effectiveness of abrading action. The high-pressure sand-blast is now recognized as the standard for general foundry use.

EFFECT OF AIR PRESSURE ON ABRASIVE ACTION

While the travel of compressed air through a pipe or hose is approximately the same at all pressures above one atmosphere, the velocity of the abrasive after leaving the nozzle increases very rapidly as the air pressure is increased, with correspondingly greater blasting effectiveness. This permitted the use of small, easier handled hose and small nozzle, in place of the large, cumbersome hose and nozzle, with a very decided saving in labor to the tonnage cleaned. Better operating conditions were obtained also through reduction of dust created by disintegration from the lesser volume of sand used. Some better understanding of this will be possible from the results of tests made. These show that the amount of sand blown at 30-lb. pressure to remove 1 lb of metal from an iron bar was 3361 lb., while at 70-lb. pressure the required sand was but 2043 lb., or over 50 per cent. more at the lower pressure, the same size nozzles being used in both instances. Of the reusable sand there is only 17.2 per cent. difference in favor of the lower pressure.

The amount of metal removed per 100 cu. ft. free air per min. flowing was, at 30-lb. pressure, 0.1969 in., and at 70 lb., 0.4473 in., or nearly two and one-half times as much accomplished at the higher pressure, with no increase in time and labor.

AIR CONSUMPTION

The amount of air consumed in sand-blast operation is governed entirely by the size of the nozzle opening and the pressure maintained; this feature is therefore one that should have the most careful consideration of the prospective sand-blast user. Constant wear, varying with pres-

**Abstract from an address before the Newark Foundrymen's Association by Mr. Gates of the Pangborn Corporation, Hagerstown, Md.*

sure and abrasive, is occasioned in the nozzle, and a very little enlargement means considerable increase of air consumed and horsepower as well.

For instance, a nozzle with ¼-in. opening flows 76 cu. ft. of free air per min. at 70 lb. pressure, as in the sand tests above, requiring 12.7 hp. to develop. Increase this opening 1/32 in., and the air flow increases to 85.5 ft., or 12.5 per cent., and horsepower requirement is 14.3. An enlargement of 1/16 in. increases the air flow to 118 cu. ft., or 16.5 per cent., with horsepower developed 19.9. And if the increase reaches ⅛ in. the air flow jumps to 171 cu. ft., or an increase of 125 per cent., while the horsepower developed rises to 28.6. If this wear, therefore, can be eliminated, obviously much power expense will be saved as well as constant pressure maintained.

The construction of the modern sand-blast room is sheet steel made dust-tight, with fresh air inlets around the sides near the base, the dust-laden air being carried off through a hood in the ceiling of the room by a powerful exhaust fan. The volume of dust created will be governed by the character of work cleaned, that is, whether plain surfaces to which little sand adheres, or intricate shaped pieces from which cores must be blasted; also whether sand or metal abrasive is used, and, if sand, its friability.

Constant change of air should be provided as the character of the work may demand. The natural tendency of the dust is to rise, and this is aided by the intake of the air at the base of the room and its drawing off through the ceilinig.

Electric light fixtures are provided, with white enameled reflectors, set into the ceiling of the room and covered with discoloid fronts to protect the lamps from flying abrasive. Ventilation and free observation of the work being so essential to quantity production, these features should not be slighted.

The room can be equipped as the demands of the plant and its output require. Large, heavy castings should be loaded at the molding floor on to grated top cars, the track extending into the sand-blast room and the pieces cleaned on the car without unloading. If the plant is equipped with a monorail this too can be extended into the room and the pieces cleaned while hanging without other handling. For small work a grated top bench can be provided where convenient, and for very small pieces much economy will be found in cleaning on the grates, it having the advantage of saving on tools and giving, without extra time and cost, clean scrap which is particularly advantageous and even necessary in the use of some types of electric furnace.

HYGIENIC ROOMS

The trend toward hygienic rooms that entirely remove the operator from the sand-blast inclosure has developed devices of different types that meet every demand. The hygienic room is provided with a sight screen on four sides through which the operator may see his work, while below this is a nozzle slot or opening, closed by sectional flexible curtains, through which the operator directs the nozzle on the work to be cleaned. While this permits the operator to work in the open and without other protection than afforded by the room, ventilation is necessary that the created dust may be rapidly removed so as not to obstruct illumination and free observation of the work.

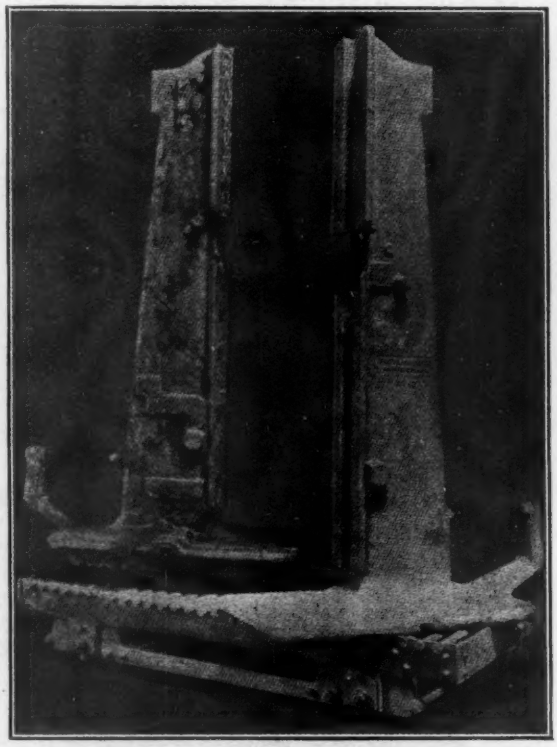


FIG. 2—CASTING FOR MACHINE TOOL BEFORE AND AFTER SANDBLAST.

Rooms of this nature are more adaptable to work of rather uniform size, as the width and length of the room should be such as to bring the work reasonably close to the nozzle slot on all sides and keep ventilation requirements at the minimum. These rooms are particularly adaptable to large and heavily cored work, and for cleaning long lathe beds and other work of this nature, and are usually constructed of a length to receive a little more than half the longest piece,

with the other half extending through the curtains closing one end of the room, the pieces being reversed for cleaning the other half. In this way pieces 20 to 30 ft. long are readily cleaned in a room of size but little more than half their length.

For the plant that has a tonnage of small work sufficient to warrant special equipment, the barrel sand-blast or the rotary table sand-blast, or both in combination, will be found time and money savers. These units are self-contained, the spent abrasive falling through perforations in the drum and delivered to a hopper, from where it is raised by an elevator, cleaned and screened, and delivered by gravity to the nozzles for reuse

FIG. 3—SANDBLAST CABINET FOR BRASS WORK.

automatically. In this type of barrel the interior of the drum is entirely unobstructed, and it will receive pieces up to the limit of the door opening size. Plow points are typical work for a barrel of this type. Other barrels of the suction type have a manifold running through the center with a series of nozzles and as the abrasive falls through the drum perforations it is passed through a series of screens to feed boxes from where it is raised by suction to the nozzle, and in combination with the air projected onto the work. Barrels of this type are more efficient for smaller pieces, such as valve bodies and the like, and from which they will remove the cores.

There is, as much advantage in the cleaning of brass or aluminum castings with the sand-blast as in the ferrous metals and cleaned on the the gates means economy of time and labor with thoroughly cleaned scrap. For the small jobbing brass foundry a self-contained unit in the shape of a sand-blast cabinet meets the requirements from every point of view. The initial cost is not large, floor space required is small and being of the suction type, is self-contained and continuous feeding as well as hygienic, the operator not being exposed to the dust-laden air.

Being simple of manipulation, they can be operated by unskilled or boy labor. These machines are made in various types and sizes, the one illustrated here being 3 ft. wide by 2 ft. deep, with a door opening 10 in. high. Pieces to be cleaned are laid on the grated floor of the cabinet and the operator handles the pieces through arm holes equipped with rubber gloves and canvas gauntlets, seeing the work through a wire and glass-covered opening provided for the purpose.

DUST ARRESTERS

For suppression of the dust created, the simplest arrangement is settling chamber with baffles that retain the heavier particles, and even this device is found satisfactory only in widely separated plants and where the operations of the foundry do not include machine work.

Where absolute suppression of the dust is not demanded, the centrifugal dry process arrester has been found highly efficient. From 90 to 95 per cent. of the created dust is retained in the arrester and discharged through the bottom to a receptacle from which arrangement for removal can be made as desired.

Where, however, entire suppression of all dust is required the cloth screen type of arrester is necessary. This is a steel case in which are located a series of specially woven cloth screens, the dust-laden air entering on one side, the screens retaining all dust and permitting passage only of the cleaned air which is drawn out the opposite side through the exhauster. A decided saving has been made in a great many plants through the use of this cleaned air which, being warm, can be returned into the plant ventilating system or directly to the sand-blast room, as conditions may warrant.

So effective are these arresters that by their use sand-blasting has been possible in large city office buildings and the diverting of the clean, warm air to plant ventilating systems has saved much in fuel where this has been done.

ABRASIVES

With the progress in sand-blast equipment and methods has come also progress in the matter of abrasives. Various classes of sand are now mined

and graded for sand-blast use, and with the abrasive, as with the equipment, the better the quality the greater the economy and efficiency. The sand which is hard, sharp, clean, with the least disintegration, not only shows longest life and highest abrasive quality, but creates less dust. River or bank sands are rarely economical, even at lowest first cost. Ocean sands are quite satisfactory, but undoubtedly the white silica sands where available are most desirable. In fact, by their hardness and uniformity they would undoubtedly prove most economical at a considerably higher first cost.

Metal abrasives in the form of chilled shot, crushed steel, etc., are produced by different manufacturers, each making claims for their superiority. Of the life of the metal abrasives over sand there can be no question and this will range from 20 to 60 times. Disintegration is at the minimum and almost no dust is created from the metal abrasive itself.

In this connection, however, the much higher first cost demands an absolutely tight enclosure throughout, as any daily loss, even though small, will soon wipe out the saving in efficiency.

The selection of sand or metal abrasive will present several features for consideration. If the work to be cleaned is reasonably free from sand, considerable advantage in operating conditions will be found by use of the metal abrasives owing to their creating practically no dust by their own disintegration, but if the work is cored or carries a large volume of sand the advantage from the metal abrasives in this connection will, obviously, be greatly decreased, and the dust created by the disintegration of the blasting sand itself will not materially increase the dust volume arising from the castings.

Where pieces are to be galvanized or plated some complaint has been registered against the metal abrasives in that the fine metallic dust adhering to the pieces prevented satisfactory results in plating, but for general foundry output the character of the work itself with the delivered cost of the various abrasives will readily determine the economy of one over the other.

All of the modern sand-blast devices operate with equal facility with either sand or the various metal abrasives.

The water power of Brazil is about ten times as great as that of Canada. That is to say, Brazil could generate about 1,000,000,000 (how the billions are coming into fashion)! horse power from her rivers. The falls of Paulo Alfonso, near the outlet of the San Francisco River, between Bahia and Pernambuco, are alone reckoned to be equal to Niagara.

SUPERCHARGING THE AIRPLANE ENGINE

When actual flight by a machine heavier than air was first achieved the feat was hailed by the world as the successful solution of one of the great problems of the ages, which, indeed, in a way it was, but in fact it was also the propounding of an unending series of other most difficult problems which challenge the ingenuity of the world's inventors.

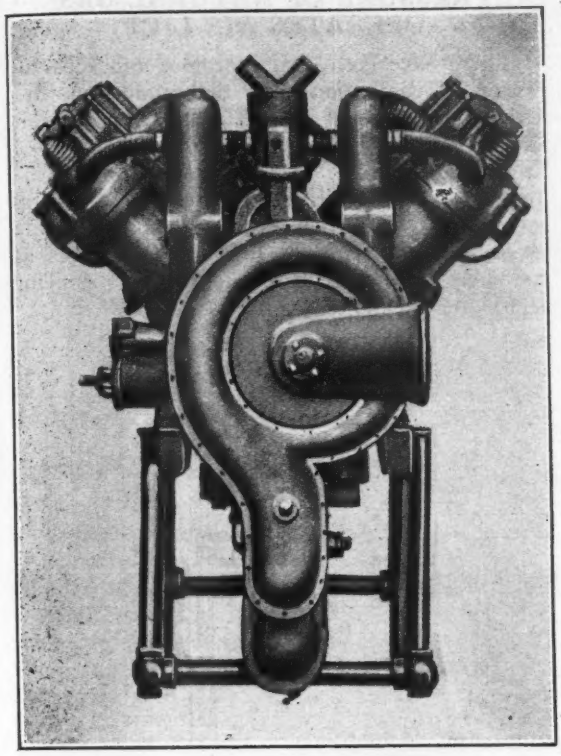
When it comes to practical and continuous flight it is necessary for many reasons to be able to operate at considerable altitudes, and at once difficulties are encountered. The rarified atmosphere affects not only the pilot but also the motor, so that at approximately 20,000 feet the engine develops, other things being unchanged, but 50 per cent. of its sea level horsepower. At the same time, to compensate for the lack of support afforded by the varified atmosphere the speed of the airplane must be increased materially, and this increased speed cannot be obtained on account of the lowered power of the engine.

This matter has been written up very completely in a recent issue of the *Scientific American* by Mr. Benjamin S. Foss, and from that article the following is abstracted:

For a long time it has been recognized that, if the air density at the intake of the engine were held constant, the horse-power of the engine would be maintained. The physical properties of the atmosphere remain the same at all altitudes, it being merely a question of increasing the density to approximately sea-level conditions, to maintain the sea-level power of the engine. This is a question of forced draft.

The difficulty of applying forced draft, as it were, to the engine has been to develop a device sufficiently large to furnish the volume of air necessary, capable of producing the required air pressure and at the same time, light enough to be used on an airplane. Moreover, the means of operating this device has been a controlling factor, inasmuch as variable speed is desirable to vary the air pressure and volume according to changes in altitudes and atmospheric density.

At the recent Aero Exposition in Madison Square Garden, a prominent American manufacturer exhibited a rotary blower, mounted on a well-known type of airplane engine. This blower is the result of two years' development and test on the part of the company's engineers, and now for the first time was publicly shown. The device, which is called a "super-charge" fan, consists of a high speed rotary blower, mounted on the engine bed and driven by the engine, through



AIRPLANE ENGINE CHARGER.

a variable speed mechanism. The blower consists of a fan wheel, cut out of a solid billet of steel and enclosed in a spiral aluminum housing. The fan is mounted on ball bearings and driven through a chain of gears with final belt connection to the engine. It operates at 10 times engine speed, approximately 15,000 revolutions per minute. It is stated that the fan will deliver a pressure as high as 14 pounds per square inch, which performance is certainly unusual in a single stage fan of this description.

The blower is entirely automatic in operation and is controlled by a barometric device connected with the variable speed drive, whereby the air pressure is increased proportionately to the air density. The blower comes into operation at a low altitude, and gains speed gradually, until it is operating under full load conditions, at approximately 20,000 feet altitude. The power of the engine, which would be lost through change in atmospheric density, is thereby recovered.

It is interesting to compare the results achieved with this device as against the results without it. The engineers supply the following significant figures:

The engine shown in the illustration weighs 480 pounds, and is rated at 210 horse-power at sea-level. At 20,000 feet altitude, this engine normally develops about 100 horse-power. The engine with the super-charge blower weighs 530 pounds and develops 210 horse-power at sea-level. At 20,000 feet altitude, however, the horse-power remains the same, namely, 210.

The Liberty engine develops approximately 400 horse-power at sea-level and weighs 860 pounds. At 20,000 feet, the horse-power developed is less than 200. With the super-charge blower, the weight becomes 910 pounds, and the horse-power at 20,000 feet is maintained at 400.

The superiority of the first engine over the second at 20,000 feet is remarkable and should be noted. The smaller engine develops only one-half the power of the larger at sea-level, but, equipped with the super-charge fan, it develops slightly more power at 20,000 feet. Moreover, the difference in weight is 330 pounds, in favor of the smaller engine. At this altitude the weight per horse-power is 2.5 pounds for the smaller engine and 4.3 pounds for the Liberty engine.

The development of a successful super-charge blower opens up enormous possibilities in the aircraft field, and it would seem that the future holds much in store for the successful application of such a device to all military and high speed airplanes, designed to operate at high altitudes. The theoretical possibilities of high speed at high altitudes are almost unlimited. In fact, the human element is the only factor that would seem to constrain progress in this direction. It is probable that the development of the super-charge idea will be applied to the human occupants of the plane as well as to the engine, and imagination pictures airplanes of the future proceeding through the upper strata of the atmosphere, 30,000 to 40,000 feet above the earth, at speeds of from 300 to 500 miles per hour.

AUTOMATIC HIGH SPEED TURBO BLOWER

We here illustrate an interesting turbo blower unit recently installed by the Rateau-Battu-Smoot Company, New York, for the International Nickel Company at Port Colborne, Ontario, Canada, W. O. Wotherspoon, Consulting Engineer, 43 Exchange Place, New York.

Fig. 1 shows the complete apparatus as installed, and Fig. 2 shows the same with the upper portions of the casings removed. The machine has a capacity of 15,000 cu. ft. of free air per min., delivered at 15 lb. gage pressure. The

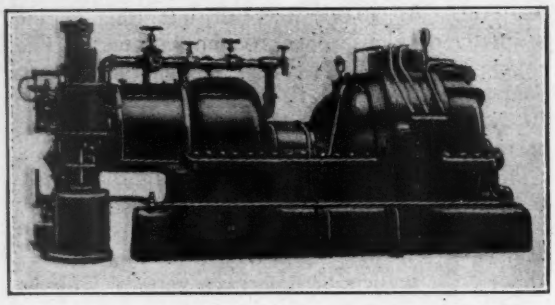


FIG. 1—COMPLETE APPARATUS INSTALLED.

speed of rotation is believed to be the highest ever employed for a machine of this capacity and type.

The driving end of the machine, at the left in the illustrations, consists of a three-stage steam turbine in which the wheels are forged integral with the shaft. The turbine develops a maximum of 700 h.p. with steam at 150 lb. gage, 100 deg. F. superheat and 1 lb. abs. exhaust. The turbine and the blower shafts are connected by a flexible-pin type coupling.

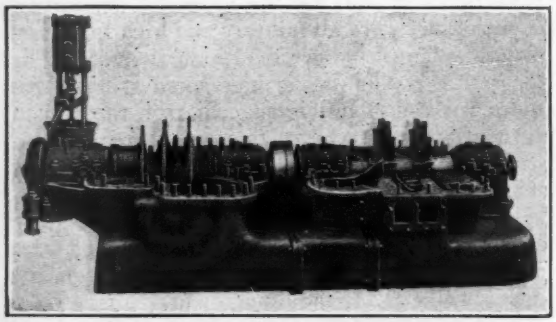


FIG. 2—APPARATUS WITH UPPER PORTIONS OF CASINGS REMOVED.

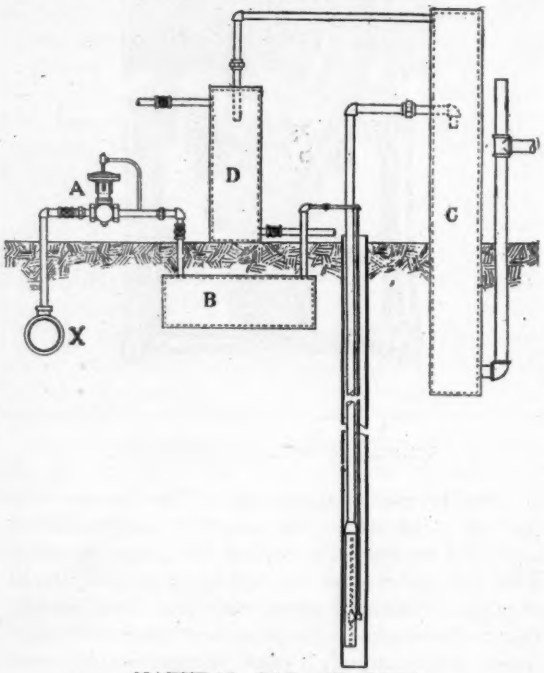
There is a sensitive, constant pressure regulator, and, as the air delivered is for use in copper converters, a stabilizer has been added to permit the blower to run without surging at all loads.

A safety device to prevent over-speeding is also provided. This consists of a small fan on the outer end of the turbine shaft which maintains a definite pressure on a tripping device controlling a butterfly valve in the steam line.

The proposed tunnel for connecting Denmark and Sweden will start on the eastern side of the Amagar Island. Construction, however, will be commenced by sinking shafts on the island of Saltholm. The tunnel, which will be in limestone throughout, will be 11 miles long, while the total length of the railway will be 31½ miles.

PRESSURE OF NATURAL GAS OPERATES AIR LIFT

There have been such enormous and constant wastes in connection with the production, distribution and use of natural gas that an example of real economy in the service is deserving of special notice. In the neat and ingenious arrangement here presented the pressure of natural gas is employed for the lifting of water precisely as air is used in the air lift, and when the gas has done this work it is returned to pipes for legitimate use and none of it is wasted.



NATURAL GAS AIR LIFT.

The description and illustration has been prepared by Mr. G. E. Howard, Master Mechanic, Ohio Fuel Supply Company, Columbus, Ohio, the publication being by permission of the Natural Gas Association of America.

Gas from a high pressure line is passed through the small regulator "A" to reduce it to the pressure at which the wells will flow the greatest volume without blowing through. From the regulator it goes into the surge tank "B" to neutralize pulsations. Passing out of this tank it flows the wells in the manner of an ordinary air lift.

In order to recover the gas, the mixture of gas and water is discharged into the trap tank "C." From here the water flows out through the riser pipe opening out of the bottom of the tank. The tee in this pipe should be at sufficient height to prevent internal pressure from forcing the water

level down to the outlet, and allowing the gas to escape. This vertical distance will be determined by the pressure to be carried in the fuel line. A vent should be left in the highest point of the riser to prevent siphoning.

From the trap tank, the gas passes out at the top and into the drip tank "D," from where it goes directly into the fuel line. Whatever amount of water is carried over from tank "C" will collect and can be blown off through the drip in the bottom of tank "D."

The tanks can be conveniently made by welding heads into pieces of 18" pipe.

NOSE-CLIPS FOR RESCUE APPARATUS

A memorandum on "Nose-Clips for Rescue Apparatus" has been prepared by Dr. Henry Briggs in connection with the work of the Mine Rescue Apparatus Research Committee, which is carrying on investigations under the (British) Department of Scientific and Industrial Research.

HOW NOSE CLIP IS APPLIED—THE LEFT HAND PICTURE SHOWS THE SCREW-CLIP, THE RIGHT HAND VIEW SHOWS CLIP USED AT SWANSEA RESERVE STATION.

As was instanced by the death of a rescue man at the Podmore Hall Colliery in January, 1918, a gassed and struggling man may not only displace his own nose-clip, but may also make his rescue difficult by knocking off those of his companions when they come within reach. Similar cases occurred in operations with Proto apparatus at the front. The problem of obtaining a clip which securely closes the nostrils while being difficult to displace, has been considered by the Committee, and, in view of the importance of the matter, they deem it advisable to publish a description without delay.

Fig. 1 illustrates a screw-clip, designed by Dr. Briggs, which is safe and comfortable. Dr. Tissot's method of fastening the clip to the skull-cap has been adopted. The skull-cap is that of the Proto apparatus, to which ear-rings have been sewn. The mouthpiece and nose-clip are held on by adjustable bands, each of which ends in the spring-hook of a watch chain. The wearer soon becomes familiar with the loop on the ear-ring to which each spring-hook attaches, and the arrangement expedites the operation of "harnessing up."

The bridge bar of the nose-clip passes under, instead of over, the nose, and the tension of the bands passing across the cheeks is taken by a narrow linen strip crossing the nose. The broad soft oval pads closing the nostrils, and the screws which adjust them, resemble those of the clip which is in regular use at the Wath station.

The form illustrated cannot drop off when the wearer's nose becomse slippery with perspiration; and, as no part projects above the nose, it is unlikely to be disturbed by an accidental blow. It has been tried at the front with satisfactory results, and at the Edinburgh station, where it is liked by the trained men. The Committee has decided to have a number of these head dresses made, and to distribute them as samples among rescue stations and makers of rescue apparatus.

Fig. 2 shows a clip which has given satisfaction at the Swansea rescue station, and which possesses considerable security against accidental displacement. Though not so comfortable as the first variety, it may be preferred by those accustomed to the spring clips. It will be observed that the wire from which the clip is formed is caused loosely to encircle the metal portions of the mouthpiece. A piece of elastic draws the legs of the clip together. The German screw-clip is similar in type, but heavier, and less secure.

AUTOMATIC CONTROL OF MOTOR-DRIVEN COMPRESSORS

We present here one of the latest practical solutions of the always interesting problem of providing apparatus for the automatic control of motor driven air compressors. The device originates with the British Thomson-Houston Company, Limited, of Rugby, and for the illustrations, and description we are indebted to *The Engineer,* London.

The apparatus is intended (*a*) to unload the compressor before starting and until full speed of the motor is reached, and on stopping; (*b*) to stop the motor when the consumption of air

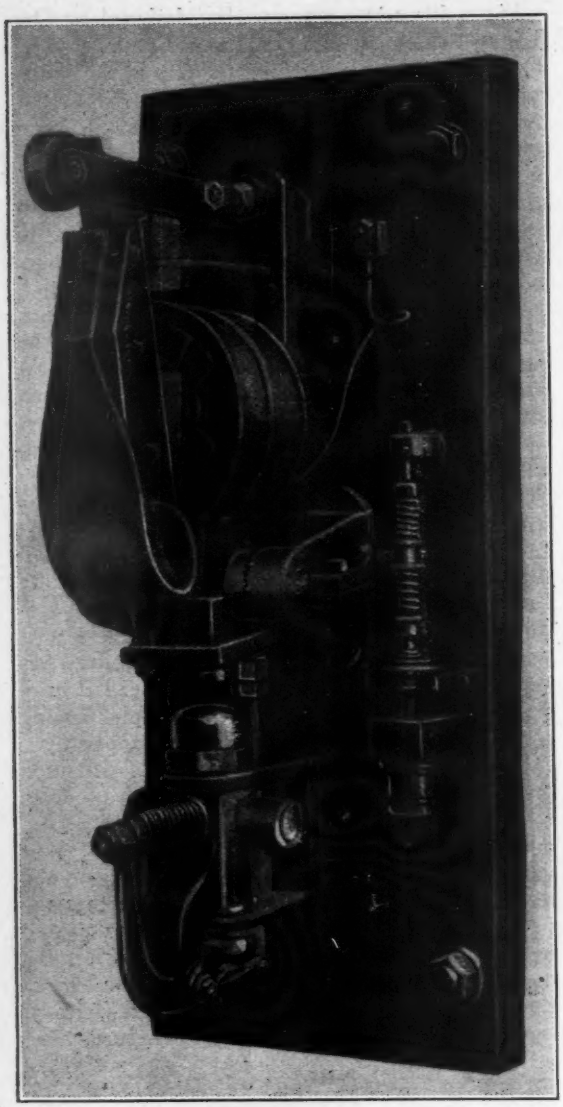


FIG. 1—AUTOMATIC VALVE FOR AIR COMPRESSORS.

is small relatively to the capacity of the compressor, and when the pressure in the receiver rises to a certain predetermined maximum; (*c*) to start it again when the pressure has fallen to a predetermined limit; and (*d*) to make it possible, when the consumption of air approximates to the full capacity of the compressor, to run the motor continuously, the compressor being loaded and unloaded at minimum and maximum pressure respectively. In whichever manner it is determined to operate the compressor—either intermittently or continuously—no further attention is, we gather, required after the closing of the main switch, the subsequent operations being entirely automatic.

The essential parts of the apparatus are as follows: (1) Pressure governor; (2) contactor starting gear; (3) magnetic pilot valve; (4) time lag device; and (5) lever switch. A main unloading valve and a non-return or check valve are also required, placed on the delivery side of the compressor.

The magnetic air valve is a combination of an electro-magnet of the contactor type, a two-way valve, and a small switch controlled by a dashpot—see Fig. 1. These parts are not of the nature of untried apparatus, but are such as have been commonly used on British Thomson-Houston contactor panels or in steam locomotive practice, and have demonstrated their reliability in actual use for years. They are supported on a slate base with corner feet for bolting to a vertical surface. In the drawing—Fig. 2—the compressor is represented as being at rest with the receiver fully charged. The valve V_1 being open, admits air from the receiver to the unloading valve, thereby opening the compressor cylinder to atmosphere. When the demand for air is such that the pressure in the receiver falls to a predetermined minimum the pressure governor switch A closes, and by doing so energises and closes the auxiliary contactor B and the interlock C attached to it. Current then passes by way of interlock C to the main coil D of the automatic starting gear and starts the motor. The starting contactors are not shown in the diagram for the sake of clearness. Each contactor operates under current limit control, *i. e.*, the second contactor cannot close until the starting current, which had risen when the first contactor closed, has fallen to a predetermined figure, and so on during the complete operation of starting.

As yet the pilot valve solenoid F is not energised, its circuit being interrupted by the interlock E, which is attached to the last main contactor. The valve V_1 of the pilot valve therefore remains open and air passes from the receiver to the unloading valve. At the moment when the last contactor closes and cuts out the last section of the resistance the motor having then attained full speed, the interlock E closes, and current then passes the pilot valve solenoid F, which closes, thereby forcing down the rod G, closing the upper valve V_1, and cutting off the supply of air from the receiver. At the same time the valve V_2 opens and the air contained in the unloading valve is free to pass through the pipe H, the lower valve V_2, and out at the opening J. The unloading valve then closes and loads up the compressor. It will be realized that the load is

not applied until the motor is up to speed. The closing of the pilot valve solenoid F also closes the interlock K, which is in parallel with the interlock C.

When the demand for air decreases and the pressure in the receiver rises to the predetermined maximum the pressure governor switch A opens, thus opening the auxiliary contactor B and the interlock C. The pilot valve solenoid F is then de-energised, the rod G is forced upwards by means of the spring Q, the lower valve V_2 closes, and the upper valve V_1 opens. Air from the receiver then passes once more through the valve V_1 to the unloading valve, which opens, and in doing so unloads the compressor. During this period the main contactors are not affected, since they are kept closed by the interlock K, the move-

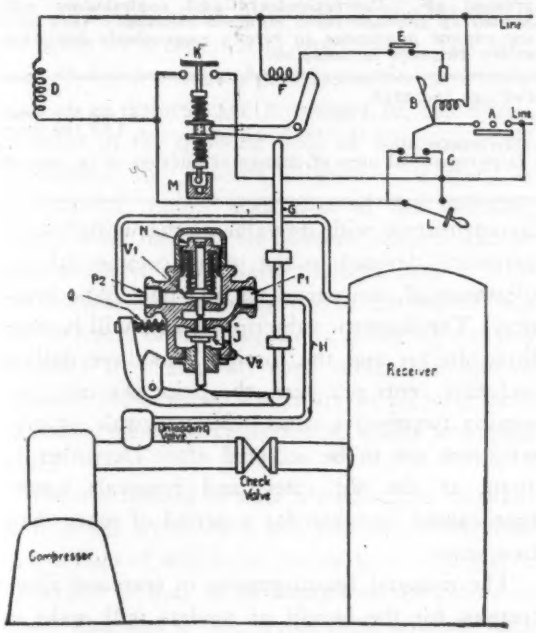


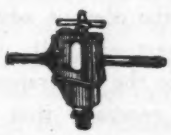
FIG. 2—SHOWING WORKING OF AIR VALVE.

ment of which is delayed by the dashpot M. After a predetermined period of time has expired this interlock opens, trips the main contactors, and stops the motor. It will be noted that the motor is not stopped until the compressor has been unloaded.

By closing the lever switch L the compressor will run continuously, the pressure governor A then having no effect on the main contactors D, but only on the unloading valve through the operation of the pilot valve. The compressor is, under such conditions, loaded or unloaded at the minimum and maximum pressures respectively.

When large multi-stage compressors, which involve the use of intercoolers and much piping, are used, the continuous loading and unloading of the compressor means a considerable loss of compressed air. In such cases it is recommended that two air valves be employed instead of one, the first air valve operating on the air intake side of the compressor and the second one on the delivery side. As an interval of time elapses between the operation of the two air valves, *i. e.*, between the closing of the intake and the opening of the delivery, the compressed air contained in the system is allowed to be forced through to the receiver before unloading takes place, so that when the delivery side is opened to atmosphere it is practically at atmospheric pressure.

The claims made for the apparatus are summed up by the British Thomson-Houston Company as follows: (1) The control is entirely automatic; (2) the motor starts unloaded, so that current and time are saved; (3) the starting current cannot exceed a certain predetermined limit; (4) the compressor is unloaded before stopping, thus avoiding sudden stresses; (5) power is saved, as the compressor runs only when air is required; (6) if preferred, the compressor can run continuously, automatically loading and unloading as required; (7) wastage of air with large multi-stage compressors is avoided; (8) decreased wear and tear of the compressor, due to the absence of severe stresses when starting and stopping. The air valves described in the foregoing are made for pressures up to 300 lb. per square inch, an adjustable spring being provided for adjusting to the pressure required. They are made in two types for alternating and direct-current circuits respectively and to suit voltages up to 550. They are supplied either as separate units or may be combined with a pressure governor on the same base.



The cheap production, by American chemists of helium, the non-inflammable gas, is one of the most notable developments of the War. If Germany could have filled her Zeppelins with it there would have been a different story to tell of their accomplishments in the War. When we entered the War the Allies told us that there was a crying need for a balloon gas that would not burn, and they suggested that our chemists pay some attention to helium. The efficiency and success of the attention given is shown by the fact that the cost of production was brought down from $1500 to 10 cents per cubic foot, and even this figure may be lowered.

COMPRESSED AIR MAGAZINE

Established in 1896

COMPRESSED AIR MAGAZINE CO., PUBLISHERS, EASTON, PA.

Devoted to all useful applications of compressed air and to everything pneumatic

NEW YORK: Editorial and Business Offices, Bowling Green Building, No. 11, Broadway.
Telephone: Bowling Green, 8430; Cable Address: "Compaire" N. Y., Western Union Code.
LONDON OFFICE: No. 165, Queen Victoria Street

VOL. XXIV, NO. VII. *JULY, 1919.*

W. L. SAUNDERS, *Editor*

FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor*

CHARLES A. HIRSCHBERG, *Business Manager*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

Subscription rates—Postage Included

The United States, American posessions and Mexico.....$1.00 the year
Dominion of Canada and other foreign countries..... 1.50 the year

Single copies—Ten cents

NOTE—Subscribers will please notify the Circulation Department at once of change of address or in case of belated delivery or non-delivery.

PUBLISHERS' ANNOUNCEMENT

WITH THE completion of the present volume of COMPRESSED AIR MAGAZINE (in December, 1919), the publication will have an entirely new typographical dress. It further will be modernized by increasing the size of its pages to the lately adopted standard of the trade press, 9x12 inches. This will make the advertising measurements uniform with those of many other contemporary technical and trade periodicals, so that advertising plates may readily be interchanged to the obvious advantage and convenience of advertisers. It will also permit greater freedom in the illustration of text matter, and betterments generally that are not possible with the present size of page. The change in size cannot be made sooner as it would conflict with the binding of volumes of the 1919 issues.

Although it is anticipated that improvements constantly will be apparent throughout the remainder of the calendar year, in keeping with lately developed plans of the publishers, they will depend for fullest expression upon the change in size to be effective as of January, 1920.

Beginning with the latter date, we also desire to announce, the subscription price for the magazine will be advanced to a point more nearly commensurate with its value as the world's only periodical devoted to the useful commercial applications of compressed air and pneumatic practice. The domestic subscription rate will become three dollars and the foreign rate three dollars and fifty cents per year, the price per copy becoming twenty-five cents. No renewals of subscriptions are to be accepted after December 1, 1919, at the old rates, and renewals meantime cannot be taken for a period of more than two years.

The material improvements in text and illustrations for the benefit of readers will make it requisite that advertising rates shall also be increased somewhat. We have carefully deliberated this point and consulted some of our advertising patrons. These have agreed that the increase might reasonably be made to afford advertisers the benefit of the kind of service they would logically expect and demand under the more ambitious publication arrangements contemplated.

A revised rate card is therefore to be issued and distributed on October 1, effective as of January 1. After the latter date renewal contracts or new business will be subject to the new rates without discount, as the prices will be net

and flat. Between the present time and January 1 new advertising contracts will be accepted at the present card rates, but without discounts formerly allowed.

Rates for space in this magazine on the present actual circulation basis of 15,850 copies; have been much too low for service and value given. They have not been commensurate with the production costs of the publication, which, in only a few years of its quarter century of existence, has ever paid a dividend. When there have been dividends they have always been devoted to the betterment of the magazine.

This journal has not been conducted in the past, and will not be conducted in the future, in the spirit of a commercial enterprise. The mission of COMPRESSED AIR MAGAZINE is wholly that of an informative messenger on the developments in the growing field of compressed air application and kindred subjects. Its spirit is professional, rather than that of the counting room, as we feel sure its old-time readers will be glad to attest. We have, perhaps, been a little old-fashioned and conservative in this regard, but the directors of the magazine's policy do not feel impelled to change it, even under the altered plans of publication, which are in response only to requirements of convenience, utility and good taste.

We are pleased to note a modest but constant gain in our circulation, and also in our advertising, neither of which are the result of having been solicited. It may be of interest to the reader to know that this is one of the most unusual technical publications in the world in that it has very rarely, if ever, solicited advertisements. We have no advertising manager.

For the benefit of our readers, however, who are interested in, and in the market for, all manner of pneumatic and compressed air devices and machinery, we contemplate inviting, by mail at least, other manufacturers, not already represented in our columns, to engage space in these pages for the year 1920. We earnestly believe this will be for their own best interests and the advancement of the entire air compressor, pneumatic tool and allied industries. All should be represented, we feel, in the only publication of either America or Europe that covers this particular field.

The editors wish to take advantage of this occasion, for we very seldom mention the affairs of the magazine in its columns, to thank the many friends of the magazine at home and abroad for their kindly coöperation in offering helpful ideas and suggestions, most of which have been privately offered. We are of opinion that many of such letters might better be published hereafter to the advantage of engineers, producers and other technologists in the compressed air field. We shall therefore welcome, henceforth, all such utterances, for publication.

PROF. PARSONS DILATES ON "ART" IN TECHNICAL ADVERTISING

AT THE LAST monthly meeting and dinner in New York of the Technical Publicity Association, before the summer recess, the 150 members and guests present enjoyed an unconventional discourse by Mr. FRANK ALVAH PARSONS of the New York School of Fine and Applied Arts on the subject of "Art" in Advertising. We timorously put the word *Art* in quotation marks as a direct result of having been hearers of the sentiments propounded by Professor PARSONS in his helpful and witty address.

COMPRESSED AIR MAGAZINE wishes that every one of its advertisers and every other manufacturer and machinery man might have heard every word Professor PARSONS had to say. He made a distinctly valuable contribution to current advertising literature. We should be vain to attempt to convey his message to our readers or to interpret it, for to do it justice Professor PARSONS' personality would have to go along with it—that is, for one to obtain the entire effect of his words. His opposition to prevalent ideas on art and what that terminology means in its catholic sense, may be profitably considered, however, by every machinery advertiser or manufacturer.

To use the word *art* or *artist* as they are carelessly flipped about in daily use is to flaunt the red bandanna in the face of this baited one of Upper Broadway. After one recognized publicity expert had been heard by the diners, on the occasion to which we have referred, Profes-

sor PARSONS challenged with the declaration, "there hasn't been a word said tonight that touched *art* in any way." And that was the subject assigned to the speakers of the evening!

Art was what required to be straightened out in our minds. There are many misconceptions about it, not alone in the advertising field, although that contains "many of the most ignorant persons in the world," (joyful laughter) but among architects, painters, interior decorators and other persons—believe Mr. PARSONS after twenty-five years of experience. It is not strange that there should be misconceptions about it among advertising men, because advertising is among the newest of the world's arts, which exists as an expression of something that really was demanded by public conditions, by social, economic conditions. The world had gotten so big, nations had become so commingled and people were so multiplied, that the individual human being could not get to every person to whom he wished to sell his product. Advertising came about when people couldn't reach their human objective first hand, face to face.

Professor PARSONS declares "when an individual has any idea to sell—I don't care what it is—it requires art. It requires art for a clergyman to get a call to come even to a Presbyterian church. He has to sell himself to his prospective congregation before he comes. It is just the same proposition if I want to sell a machine, or curtains, or underwear, or anything else—plus the peculiar conditions of people to whom the message is to be taken."

Advertising has grown with tremendous rapidity since it first developed, and nowhere, probably, has it developed to such an extent as in the United States. Art in its application to advertising, as in other things, is nothing more nor less than expressing a thing in its clearest, most utilitarian way, "in a manner that will not make you ill."

That is all it took to build the greatest cathedral that ever was, the best of Greek temples, the worst of all New York churches, the greatest of all plays, the greatest music, the greatest literature. Advertising art is all one thing with these other things—it is an attempt to express in a utilitarian way, so there shall be a perfect fitness to purpose, any message, any idea, or anything externalized in any material whatsoever, in decent taste.

Our mentor assures us that we may put a pump on a page decently, that we may arrange the cut of a machine with whatever "copy" we have, so anybody can read it and read it easily, can understand what we want to say, and that the materials for the advertisement can be assembled in such a way or in such a relation so that it *is* in good taste. (Reasonable enough, Professor, but not so easy as it sounds).

What art is *not* strangely interested us. In the first place how dare we call people who bring around drawings to us, "artists?" (Gusts of merriment). By what right, he would like to know, do we submit to the tommyrot that we have submitted to in the name of art? Think we that every man that draws a picture is an artist? Most of them are damphools, that's what they are, and the men who take their things are more so! It isn't necessary to have a picture to have art, anyway. If there weren't any pictures, there might be a chance, maybe, for art. As long as there are so many there is no chance. An artist is not one who can draw a picture—not necessarily one even who can draw right well.

In the first place a picture, whether for advertising or any other purpose, that doesn't express an idea so that any person of common sense can get the message and the idea clearly and easily, is not the work of an artist. The artist does just that—first—and he is doing it artistically if he does it with a certain charm and feeling. There seems to be an impression that when a thing is "dolled up" enough it is art, but let us not be deceived. All that is fussed and feathered and frivoled is not artistic.

As a general proposition, prettiness is not art, age or antiquity is not art and authenticity is not art. A well known man's name does not guarantee an artistic quality for his work. If the so real peaches on the diningroom wall make your mouth water, that is not art, because art is not appetite. Art is not nature, because it is the absence of it. Nature is the work of the Creator, who attended well to it. It's not a man's business to try to imitate it, but to *adapt* it.

It was plain to be seen that we had great faith in certain people, who have drawn things, because they have a name. A thing doesn't have to be done by LEYENDECKER to be good; it needn't even have been born in Boston, where Professor PARSONS came from. In fact it isn't essential that any locality, or any price or any person should make a thing good.

Professor PARSONS observed with a good deal of iconoclastic feeling that it is perfectly damnable what the president of a trust can put in his house as he gets richer and richer and just as astounding what the president's wife can wear the more her husband looses the family purse string. "Is that *art,* for heaven's sake, just because she can buy it?" Not much. If she knew what to put on, considering who she is, and what she looks like, and where to wear things that she puts on, considering whom she will see, she *would* be an artist.

The price of clothing, as of a drawing for an advertisement or of anything else, we were made aware, hadn't a single thing in the world to do with the quality of art whatsoever.

REMBRANDT did some very bad things in his day. Great people do not produce good things all the time—nobdy ever has and nobody ever will. The greatest artist in the world is likely to be out of his best gait part of the time.

As regards the authenticity of works of *art,* Professor PARSONS has seen folk all over Europe peering at things with a microscope to see whether they are authentic. But even if the greatest critics in the world say that a thing is antiquatedly authentic it doesn't make a particle of difference—it doesn't add to its art quality. Yet with some folk if it is authentic no price is too high to be paid for the thing under consideration.

With respect to technical and other advertising we were quite emphatically informed that properly chosen colors, paper and type should be used to convey an idea. It is a pity if the quality of paper says one thing and the type another, or if the picture used should neutralize the idea.

Art, Mr. Machinery Man, is a state of mind, be sure of that. How can one see art when he is praying to see oranges because he happens to like the taste of them? How shall one ever know what art is if one thinks that fussing up a thing is art? Did one marry a Christmas tree when he married a wife, or did he marry a woman? Does one wish to see his better ¾ draped in all manner of things that do not belong on her—in a setting of a junk shop of a house called a home?

How can one go into the St. Regisbilt corridor, turn to the right, go into the reception room and come out moral? We are guilty of an insane desire in America to show off. There isn't a place on earth where size, amount, swiftness and display continue as the qualities that will get a man or woman into heaven, as they do in this country. The highest building, the greatest subway, the largest hotel, the most garish theatre, the richest man, the tawdriest woman, all exist —and we are proud of them, now aren't we?

When a thing reaches the stage of ostentation it isn't art. When a thing becomes overfed it is time to cover it up.

Art always comes as the answer to a particular need. The need for it is tremendous in advertising, because it is the bread and butter, the life of men who are using it, especially of the manufacturing men who are using it. We must know how to express the good things about a machine we would sell; we must express the answer to a need in its best terms. That is art in advertising, its language being that of color, line, form and texture, and no more. Used properly they will carry a message with the clearness and force that we need.

It makes a difference whether we use black or white, or blue or gray. We can undoubtedly advertise machinery better with black and white, but the first question is whether the shape and size on the page are correct so they will convey the right message. Color and form and line must control the arrangement of an advertisement, if the reader is to grasp the idea to be conveyed. Professor PARSONS himself has to be held in a chair while he reads most advertisements, he admits, so there must be a lot of room for improvements in the general field.

Another thing that *art* is—it is choice, the selective faculty. It is the ability to select the

right thing to tell the story. One may be an artist and yet not able to make a single drawing. If we can lay out a page so anybody can read it when it is finished, then we are artists.

The technical publicity fraternity will be grateful to Professor PARSONS for his clear exposition of principles, which were clearly recognized because of the way in which they were expressed—and that too was art!

HELPING INDUSTRIAL EUROPE GET ON ITS FEET

QUITE THE most interesting, not to say informative description of European economic conditions, though comprising a dark picture, was brought back to the United States by Mr. FRANK A. VANDERLIP recently and given to members of the Economic Club, the Civic Forum, the Mid-European Association, Merchants' Association of New York and other bodies. Most manufacturers and industrial financiers have had considerable confidence in Mr. VANDERLIP as an observer, due to his training of earlier days as a newspaperman, his experience as a government official and his career in banking to a point where for ten years he was the titular head of one of the largest aggregations of business capital in the world. He resigned as president of the National City Bank on June 3.

In a nutshell Mr. VANDERLIP discovered that continental Europe was paralyzed industrially and socially and he made the correlative finding that it was the task of the United States to relieve Europe, in self defense. The continent is in a starving condition over large areas. Furthermore food conditions, due to lack of planting at home through loss of farm animals, and due to lack of transportation facilities for food imported, are unlikely to become greatly bettered for some time to come.

Britain, he thinks we should know, was threatened by revolution, though English common sense triumphed, and he found that ogre, Bolshevism, rife in Spain, though that has been the most favored and prosperous of European countries as the result of the war. Barcelona is a hotbed of radicalism with a reign of terror caused by unpunished assassinations directed by a mysterious, secret body. The suffering in Europe for some time to come will equal, if not exceed that of actual war times.

Mr. VANDERLIP found that the best of printing presses were installed at Petrograd and were turning out unlimited quantities of counterfeit pounds, francs, marks, lira and pesetas, so skillfully made as almost to baffle detection. He declared that these false issues of money were being expended largely by Germans to foment Bolshevist propaganda.

American manufacturers began to prepare six months ago for a commercial campaign in Europe. Scores of executives and expert salesmen were dispatched to Europe; there was much hopefulness and much talk that big business would result. The market exists for goods, for machinery, for foods; there is a great yawning maw of a market, an omnivorous demand, but—the means for doing business are lacking. The industrial and financial chain is broken. Payments for goods depend upon home production, naturally, and there is no production. To pay, one must create or produce something to pay with. It cannot be done with worthless pieces of paper.

The deductions to be made from the banker's discoveries over a period of four months in seven countries are that America alone can save Europe, and that its aid must be extended impartially and equally to all of the stricken countries.

There is an "awful scar across Europe from the German border to Zeebrugge." No words can tell of the destruction wrought by minds that planned economic obliteration, but this destruction is not the greatest cancer wrought by war. It is the idleness that has been laid upon the countries by the mailed hand of war. To quote Mr. VANDERLIP:

> Now, why should a factory unharmed by the war, in the midst of a continent wanting everything, incidentally be idle? Why should there be 1,000,000 people in England receiving an unemployment weekly dole? Why should there be in little Belgium 800,000 people receiving a weekly unemployment wage? Now, let me try to give you a picture of the difficulties that a manufacturer is under in Europe today in an attempt to start his factory.

In the first place his labor has been dissipated and he faces the very difficult labor situation, although he is surrounded by idleness. The war has had a bad effect upon the morale of people. That is particularly noticeable in Belgium, where for the four and one-half years there has been partial idleness of people supported from the public purse, and the serious effect upon the character for the moment, at least, upon those people.

But our European manufacturer must have raw material. Probably it must come from out of the country. He must have the exchange to pay for it. He must have credit, very likely. Now, I have come to see these nations from a new point of view, from a point of view of what they must have from outside to sustain life and go on in a more normal course, and what they have got to pay for it with.

Let me picture a pair of balances, into one scale of which you will put all the things that a nation must have. In Italy coal and cotton. In France cotton and wool, most of the metals. Let us put in the other balance everything a nation has got to export. Well, obviously, at the moment, these nations, wanting everything, industrially disorganized, and nothing to send out—our scales are out of balance.

Now, what can be done? We cannot take anything out here, because presumably we have reduced these imports as low as they can go and have the nation live; put more in here, but you cannot put more if your industries are paralyzed. What other way is there to balance this, and it has got to be balanced? It must be balanced, else things cannot be had that are essential to the nation's life.

Well, normally we would put gold in there, but of course now there is no gold that these countries can spare. What else can we put in? Credit, that is one thing. There are just three things that will go into this balance to balance these necessary things that the nation must have—goods, gold, credit—and so right on the threshold a manufacturer needs a foreign credit. He must have a foreign credit if his raw material is to come from abroad.

Now, what are some of the other things that are difficult? He is facing a wage situation two or three times what the wages were in pre-war days. He is in a currency situation that is chaotic. Some of these nations have a variety of currency at the present time that is almost laughable except that it is horribly serious.

Mr. HOOVER is authority for the statement that the railway breakdown in Central Europe and east of Germany is so serious that there is bound to be starvation. To an American the expression "starving people" is oratorical; it is a long way off, we do not get it, we do not understand it.

Aside from the effect on food, the transportation problem affects the manufacturer in getting his raw material. It prevents him shipping his finished products. But what about his market for the finished products? There is the rub. The markets of Europe are ravenous for things, and they have got nothing with which to pay.

The manufacturer, starting with a disorganized labor situation, a wage scale three times the pre-war scale, a demoralized morale, great difficulty in getting foreign exchange to pay for his raw material, great difficulty in getting bottoms to ship it, great difficulty in getting it transported to him after it arrives at the port, must still produce. But after he produces he has not the market that can pay, a market that will give him the means to go on completing the industrial cycles of buying more raw material—paying his labor.

Europe has increased its population since the Napoleonic wars from 175,000,000 to 440,000,000. Think of those figures—175,000,000 to 440,000,000! Now Europe did not become any more productive. She probably does not raise a very great amount more food than she did a hundred years ago.

Mr. VANDERLIP's conclusion, in the face of the significant picture he has drawn, are that the whole European machine is so completely disorganized that it wont run unless we help it. We must furnish the fuel and lubricants and some intelligent and courageous engineers. Giving Europe charity will not save it—we must give charity of mind, not money. But we must get some priming into the business pump to get it started.

First of all, we must be sympathetic and then there must be a comprehensive attempt on the part of our bankers, our manufacturers to restart the European industries. We can and must help Europe to get a start toward a normal life again. It is the greatest opportunity that ever came to a people.

We can feed the world, finance the world, and provide it with raw material. Other nations have in the past been financial reservoirs, but they have not been reservoirs of raw materials as we are now. We must be careful, we must be considerate and we must be generous, or our favored position will avail us little.

Sir JOSEPH DAVIES, M. P., who has been visiting America, declared in an interview that he considered Mr. VANDERLIP had made a remarkably able analysis of conditions in continental Europe. In England, however, he said there was no "paralysis of industry." Three million of the four million men discharged from the army had already been absorbed by peace-time industries. Even half of the 500,000 women who lost their war jobs had been placed in peace time occupations. Britain suffered deeply from the war in loss of man power and wealth, but her case is hopeful, Sir Joseph declares.

"Our mines, our food production, our other industries have been so developed during the war that we are working as never before," he said. "Why, take the matter of dyes and chemicals. Before the war we imported these products mainly from Germany. Now we have developed the industry so within our own shores that before long England will be exporting chemicals and dyes.

"The British capacity for the manufacture of textiles is bigger now than at any other time. There are places for our workers in the coal mines, the iron and steel works, the shipbuilding, railway locomotive, carriage building and especially in the motor industries.

"Of course certain industries have been affected by the blockade of the European markets. This, in fact, is one of the few things that is preventing a complete return to normal conditions, and once peace has been brought about this obstacle will be removed."

EDITORIAL NOTICE

IN LINE with the new policy of the Publishers, looking towards an improvement in the service of the COMPRESSED AIR MAGAZINE to its readers, the management wishes to take this occasion to announce the appointment of Mr. FRANCIS JUDSON TIETSORT, as Managing Editor.

Mr. TIETSORT is a writer of considerable repute, having been engaged in newspaper and magazine work for the greater part of the last twenty years. His editorial connection with daily newspapers have included the *San Francisco Chronicle, Denver Evening Times, New York Herald, New York Times, New York Evening Post* and the *Philadelphia Public Ledger*. He was formerly associate editor of the *National Marine Magazine* of New York, and was the founder and editor of *Revista de Automoveis* (Automobile Review) published in Portuguese at Rio de Janeiro, Brazil, where Mr. TIETSORT remained nearly four years. He has been the author of many articles and treatises on foreign trade, industrial topics, ship-building, maritime matters and railroad transportation, his work causing him to travel widely in foreign countries, particularly in South America and the West Indies. He had been until lately Export Sales and Advertising Manager of the United States and Cuban Allied Works Engineering Corp. and the Krajewski-Pesant Corp. of New York and Havana.

The June issue which has already been distributed is indicative of the improvements contemplated and stands as a living testimonial of the exceptional journalistic ability which Mr. TIETSORT brings to COMPRESSED AIR MAGAZINE.

Mr. FRANK RICHARDS continues on the Editorial Staff as Editor of the Technical Division and Mr. W. L. SAUNDERS as Editor-in-Chief.

CHARLES AUSTIN HIRSCHBERG,
Business Manager.

Mr. John Stevenson, Jr., president, announces that effective as of June 4, the Standard Car Construction Co. and the Standard Car Equipment Co. were merged under the name of the Standard Tank Car Company. The latter company will continue the functions of the two component companies, both as to the building and the leasing of tank cars and all forms of steel plate construction. The head office and works will be at Sharon, Pa., with branches maintained at New York, St. Louis and Chicago.

Owen W. Streett, Bethlehem, Pa., has been appointed assistant to purchasing agent, Bethlehem Shipbuilding Corporation, Ltd., Union Plant, San Francisco, Cal. Mr. Streett has been a buyer of mechanical and electrical equipment at the central purchasing office, Bethlehem Corporation, for the last two years.

Books and Writers

In the Realm of Science as Applied to Industry

JOHNSON'S MATERIALS OF CONSTRUCTION, a Treatise on the Properties, Structure, Identification and Proper Use of All the Important Materials Employed in Construction. Based upon the original work by the late Dean J. B. Johnson of the College of Engineering, University of Wisconsin; rewritten by M. O. Withey, Associate Professor of Mechanics of the University of Wisconsin and James Astor, metallurgist of the A. M. Byers Co. of Pittsburgh; edited by F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin. Illustrated, Fifth Edition, XIX-840 pages. Price, cloth, $6 net. New York: Messrs. John Wiley & Sons.

WHEN DEAN JOHNSON'S original work was published some twenty years ago, he pointed out in the preface that the design of any kind of construction involved a knowledge of three things: the external forces to be resisted or transmitted; the resulting internal stresses; and the mechanical properties of the materials employed. Of these the first two are founded on the sciences of applied mechanics and mathematics, but the third, the properties of materials, does not rest on any deductive science; the information required can only be obtained by exhaustive research.

An immense amount of study and experimental research had been devoted to the properties of materials, but the information existed in many forms and many languages. Dean Johnson's treatise was prepared with the object of assimilating and digesting this information and presenting it to the practising engineer in convenient form for reference. The merit of the work is attested to by the fact that it was used widely for twenty years with little revision.

The present authors have not only brought the book up to date by adding the latest information available, but have also continued the broad scope of the former work by including essential instruction on the sources, manufacture or fabrication of the various materials, providing a book which can be used as a text as well as a reference.

The first chapter is devoted to a synopsis of the principles of Mechanics of Materials, and the various forms of deformation and stress are fully treated. In Chapter Two the newest machines for measuring stress and deformation are fully described and illustrated, and the third chapter gives detailed instructions on methods of testing, including the preparation of test specimens.

The three chapters following are devoted to a discussion of various woods as materials of construction. This section is more complete than in any similar work which has been brought to our notice, and the portions concerning identification of different woods and causes and prevention of deterioration should be valuable to the constructor. Tables showing the holding power of nails and screws in wood are complete and readily understood.

Cements and concrete are then taken up, starting with their manufacture and ending with a discussion of their varied modern uses.

The metals used in construction are fully treated in the remainder of the book. The metal ores and their reduction are first discussed, foundry and rolling mill practise is covered, and the nature and manufacture of alloys treated. Follows a discussion on the constitution and properties of iron and steel, including the alloy steels. The non-ferrous metals and alloys are then described, and the final chapters devoted to the effect of temperature, fatigue and corrosion of metals.

As a reference work on the materials used in construction, the book leaves little to be desired; since it is also designed to be used as a text, however, it is surprising that the book contains so few references to the uses of air. Compressed air is second only to steam and to electricity in this age, and plays an important part in many of the processes described in Johnson's Materials of Construction. For instance, the work makes no mention of sand rammers for foundry use, chipping hammers for trimming castings, pneumatic hammers for vibrating concrete forms, or tampers for concrete; the cement gun, and the operations of plating or painting metal for protection by compressed air are not discussed. A brief treatment of these subjects would in our belief, be merited.

—*W. P. B.*

THE SHOP COMMITTEE, a Handbook for Employer and Employee, by William Leavitt Stoddard, A. M. 125 pages. Price, cloth, $1.25 net. New York: The Macmillan Company.

IN THE PRESENT days of social unrest, any work which aims at a real practical solution of the problem of adjustment of disagreements arising between employer and employee is as refreshing as a breath of cool air on a warm day. Undoubtedly "The Shop Committee" is a step in the right direction, and Mr. Stoddard's book is valuable in that it seeks to explain the previous work that has been done, and to present in a logical way the difficulties involved, with suggestions for their solution.

The author states in his preface that his work is neither a treatise, a history, nor a complete study of the shop committee movement. This may be true, but enough material is presented to afford the careful reader an ample knowledge of the subject. Mr. Stoddard was administrator for the National War Labor Board in 1918 and in 1919, and many of the experiences related are drawn from personal observation.

The volume commends itself particularly to shop superintendents, managers and foremen, and it is to be hoped that it will enjoy a large circulation in its chosen sphere.

KEYS TO SUCCESS, Personal Efficiency, by B. C. Forbes. 250 pages. Price, cloth, $2 net. New York: B. C. Forbes Publishing Company.

THIS BOOK is inspirational in character, and contains many valuable suggestions for personal betterment. It offers no easy road to success, but indicates all the difficulties and trials which beset the path of the ambitious toiler. Many successful men are quoted and examples are taken from their success.

The work reads like a modern Book of Psalms. Most of the chapters consist of an array of gems of thought, succinctly stated, and arranged in order, forming what might be called a psychic piece of jewelry.

The reading of a single chapter every evening ought to help to produce an inspired state of mind and prove an aid to clear and right thinking.

HEAT TRANSMISSION TABLES, compiled by William R. Jones, Superintendent of Buildings and Grounds at the University of Pennsylvania, 23 pages. Price, paper $1.

THESE TABLES first appeared in the *Heating and Ventilating Magazine,* in four issues from October, 1918, to January, 1919. In their present form, they form a valuable reference for the engineer or contractor. The data is digested from the most recent experimental work in many lands, and arranged in a most convenient way.

Many materials and combinations of materials in the shape of windows and doors, walls and floors and other construction forms are considered in the tables. The builder will find in them a form closely approximating any he may wish to use, and thereby make his heating calculations easily and quickly.

MARINE GAS ENGINES, their Construction and Management. A Practical Treatise on the Construction, Installation and Operation of Internal Combustion Engines of the Marine type, by Carl H. Clark, S. B., 102 Illustrations, v-136 pages. Second edition, revised and enlarged. Price $2 net. New York: D. Van Nostrand Company.

MR. CLARK evidently has had in mind, in preparing this work, the well-nigh universal desire to understand gas engines by the man with little or no technical education. The types of engines and their principles of construction are clearly presented without resort to the theoretical viewpoint. Ignition devices and wiring are explained with numerous diagrams, and lubrication is similarly treated. Some space is devoted to reversing mechanism and propellers, owing to the fact that these must be carefully considered in connection with marine engines.

Modern heavy oil engines and multiple-cylinder engines are described and their peculiarities pointed out, and the final chapters contain some excellent notes on the installations and operation of internal combustion engines.

This work ought to prove especially valuable to the owner or prospective owner or operator of a motorboat or auxiliary-motored craft. It is issued as one of Van Nostrand's Nautical Manuals.

"Principles of Combustion in the Steam Boiler Furnace" is the title of a new work by Arthur D. Pratt, of the Babcock & Wilcox Co., which publishes the book. As assistant to Dr. D. S. Jacobus, that company's advisory engineer, Mr. Pratt devotes much of his time to combustion and heat-transmission problems. The book, therefore, embodies much of the company's practice. This excellent book is in thirteen sections, dealing with the chemistry of combustion, density, weight and volume of gases, heat of combustion, specific heat, temperatures developed in combustion, air and combustion, combustion formulas, combustion loss, smoke, general conclusions.

Section XII deals with the computation of combustion data relative to coal, wood, oil, natural gas, byproduct coke-oven gas and blast-furnace gas. Section XIII treats of the heat balance for solid, liquid and gaseous fuels. These two sections are particularly valuable.

THE MIND DRIVER

A Word with Industrial Employers

By D. C. GROVE

GILBERT K. CHESTERTON tells us that the proper hiding place for a leaf is in a forest with countless other leaves screening its identity with their numerical infinity.

The ambition of a man, the driving force of mind, too often goes into hiding in a forest of other leaves which bear it semblance, although they are of coarser strain. Too often is it hidden in the jungle shades covered by the rotten vegetation of fear and racial antipathy and deeply rutted by convention and custom. Yet it is always there, still green though perhaps dormant or sleeping.

D. C. GROVE.

In that physical reflection of a higher creative intelligence known as mind, the ambition of the worker resides as a subtly delicate balance, tipping on one side to the weight of encouragement and responding as readily on the other, to the heaviness of opposition. Just as surely as an assault upon the person is an unabidable offense in the sight of man, the deliberate suppression of ambition in another, a battery of the mind, is a crime in the sight of God.

If the mind of man could be arranged as a motion picture film and coördinated trains of thought projected upon a screen, it would be found that behind all mental process appears the nimbus of ambition, urging the thinker to "carry on."

Who can gainsay the supposition that the Fiji Islander in his barbaric simplicity has ambitions as near and dear to him as those which inspire art and drama in the minds of genius.

Are not the prattling ambitions of the growing boy to belong to the brass-buttoned grandeur of the fire department as serious to him as the dream of the ingenue of her name in flashing signs along the Great White Way?

In the autobiographies of successful men and women how often do we find the whole secret of success lying in perhaps a few words of timely encouragement given them at a crucial time by some one in the long ago.

To employers of labor is given the divining rod of power, the forked symbol of authority and guidance. Use this with sympathetic understanding; stir the tangled refuse of the forest floor of mind and rescue or revivify the wind blown seedling of ambition in the millions to whom you act as guide and mentor.

Personal Intelligence

Mr. J. W. McCabe, who until recently has been district manager of sales for the Chicago Pneumatic Tool Company, at Buffalo, New York, has been appointed special representative for the company's foreign trade department and will depart shortly for an extended trip throughout the Orient, Philippine Islands and Australia. Mr. W. H. White has been appointed acting district manager of sales at Buffalo to take charge of that territory during Mr. McCabe's absence.

* * * *

The Walter A. Zelnicker Supply Company in St. Louis has just appointed Mr. F. X. Meehan as Advertising Manager. Mr. Meehan comes to the Zelnicker organization with a very broad experience, having been associated, in various executive capacities, with Fairbanks Morse & Company, for six years; the Santa Fé R. R. Coast Lines, for two years; and St. Louis Smelting & Refining Works of National Lead Company for two years. Mr. Meehan was an active Four-Minute-Man during the World War, having made over 500 patriotic speeches.

* * * *

Daniel H. Cox, having resigned his position as manager of the Ship Construction Division of the United States Shipping Board Emergency Fleet Corporation, has resumed his original business with the firm of Cox & Stevens, naval architects, marine engineers and vessel brokers, 15 William street, New York city.

* * * *

Messrs. Wm. B. Scaife & Sons Company of Pittsburgh announce the opening on July 1 of a Chicago sales and engineering office at No. 38 South Dearborn street, with Charles F. O'Hagan, formerly chief engineer of the company at Pittsburgh, as resident engineer and manager.

* * * *

G. A. Tomlinson, the well known Great Lakes shipping man, formerly of Duluth, has resigned as director of the Inland Waterways and Canals Division, which is under the jurisdiction of the United States Railway Administration, to become resident director of the London office of the American Shipbuilding Company.

Professors Lambert and Carlson, of the Minnesota School of Mines, are heading the sophomore class of the school during their annual six weeks of practical work. They are at present at the Scranton mine, in Hibbing, studying the underground lay-out.

CONFIDENTIAL EMPLOYMENT BUREAU

With the hope and expectancy of being of real assistance both to employers seeking efficient help and to competent and experienced men in the industries in which compressed air is employed, this magazine has decided to reopen its Confidential Employment Bureau, abandoned in the course of the war. As the only periodical devoted to the subject, COMPRESSED AIR MAGAZINE will be glad to bring employers and good men together, and without charge for its services.

While we cannot assume responsibility, we shall use our best judgment respecting the credentials of those whose wants come to the attention of the re-established bureau.

Applications from either employers or employees should be directed to "Confidential Employment Bureau," Compressed Air Magazine, No. 11, Broadway, New York City. Each employment "want" will be numbered in the order of receipt and published in the next issue.

Letters in response to numbered requests will be forwarded direct to the person or persons concerned. Requests for publication must be received not later than the fifth of the month preceding date of issue.

HELP WANTED

No. 418—Channeler runner and general mechanic on quarry work required by a New England concern. Married man preferred. Must be steady and reliable. Good wages.

No. 419—Services of young graduate mechanical engineer well versed in compressed air practice and having had some experience in shop work sought by Pennsylvania factory. Write Bureau giving full details. Salary, $150 monthly to start.

No. 420—Colorado mine superintendent seeks experienced assistant. Give history, schooling. State salary expected and how soon available.

POSITIONS WANTED

No. 843—Good drill repair man wants place in far west or Rocky Mountain states. Can give excellent references.

No. 844—Engineer for building contractors, familiar with engines, hoists and compressors wants a steady position with responsible firm of contractors or engineers. Speaks and writes French and Spanish. Willing to travel.

No. 845—Engineer major, A. E. F., discharged with excellent record, seeks place with large manufacturing house in the eastern states. Fifteen years' practical experience in general mechanical engineering prior to war. Has dependent wife and two children and will accept any reasonable offer.

No. 846—Experienced man in running air compressors would like a job as compressor engineer. Employer for eight years out of business. Good references.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOTICE TO READERS:—With a view to ascertaining sentiment on the subject, we should be glad to learn from subscribers whether they consider that the space now devoted to the record of pneumatic patents is well used. It has been proposed to abolish the publication of these patents in this journal, as there is a considerable pressure on our space capacity, and there has been a suspicion that not a sufficient number of readers were interested in them, or found them of value, to make their publication worth while. If those interested in the continuance of their publication will write us we shall be very glad indeed to consider their opinions.—THE EDITORS.

APRIL 8

1,299,443. VACUUM FUEL-FEED SYSTEM FOR MOTOR-VEHICLES. Wray Falwell, Fitchburg, Mass.

1,299,477. FLUID-MOTOR. James Blaine Kendall, Chicago, Ill.

1,299,478. AIR COMPRESSOR. James B. Kendall, Chicago, Ill.

1,299,495. SAND-BOX VENTILATOR. Charles F. Mather, Erie, Pa.

1,299,547. VACUUM-CLEANER. Homer L. Boyle, Lansing, Mich.

1,299,653. VACUUM-TANK FOR FUEL-FEED SYSTEMS. George A. Arnold, Boston, Mass.

1,299,659. AIR DIFFUSER AND REGULATOR. Frank A. A. Barrs, Vancouver, British Columbia, Canada.

1,299,668. AIR LIFTING-JACK. August Blomquist, Vancouver, British Columbia, Canada.

1,299,671. DEVICE FOR THAWING DRAIN-PIPES. Lewis A. Brennar, Brandonville, Pa.

1,299,791. DRYING PROCESS. Stewart E. Seaman, Brooklyn, N. Y.

1,299,814. FEEDING MEANS FOR DRILLS. Lewis C. Bayles, Easton, Pa.

1,299,883. FLUID-OPERATED LATHE. Henry E. Warren, Ashland, Mass.

1,299,900. COMBINED FUEL AND AIR VALVE. George F. Bibb, Troy, N. Y.

1,299,901. AIR-GUN. Benjamin L. Blair, Indianapolis, Ind.

1,299,946. PNEUMATIC ATTACHMENT FOR SCHUTCHING-MACHINES. John Hubler, Brandon, Wis.

1,300,014. SPRAYING DEVICE. James W. Ranson and Otto A. Gerstung, Chicago, Ill.

1,300,016. METHOD OF AND APPARATUS FOR ENGINE-BRAKING. George B. Reed, Philadelphia, Pa.

1,300,053. AIR-LIFT PUMP. Ralph H. Tucker, Los Angeles, Cal.

1,300,073. AIR COOLING SYSTEM FOR AUTO-ENGINE CYLINDERS. Edward T. Wheeler, Akron, Ohio.

1,300,196. SUCTION-CLEANER. William W. Rosenfield, New York, N. Y.

APRIL 15

1,300,281. FLUID-PRESSURE APPARATUS. Amos L. Knight, Philadelphia, Pa.

1,300,523. LOW-PRESSURE ALARM. William E. Voss, Oklahoma, Okla.

1,300,529. FLUID-PRESSURE SYSTEM. James N. Weikly, Jersey City, N. J.

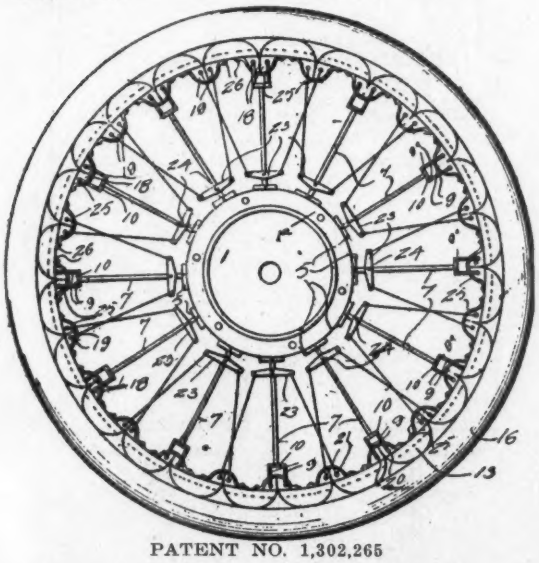
1,300,654. DRY-SPRAYING MACHINE. William H. Rose, Jersey City, N. J.

1,300,705. DEVICE FOR CHILLING AND DRYING AIR. Benjamin Joshua Du Bose, Lisbon, Ga.

1,300,727. PNEUMATIC SPRING. Josef Hofmann, Baumaroche, Switzerland.
1,300,821. VACUUM CASTING-MACHINE. Louis R. Curtis, Chicago, Ill.
1,300,823. SPRAYING APPARATUS. Arthur V. Dickey, Seattle, Wash.
1,300,898. FLUID-PRESSURE CLUTCH. Bee Elmer Vincent, Swifts, Ohio.

APRIL 22

1,301,130. METHOD OF AND APPARATUS FOR DRYING MATERIALS. Harry E. Hollister, Irvington, N. J.
1,301,131. FLUID-CONTROL APPARATUS. Philip T. Jackson, Toronto, Ontario, Canada.
1,301,167. SEMI-AUTOMATIC COMPRESSED-AIR TRANSPORT SYSTEM. William O. Renkin, Oradell, N. J.
1,301,208. CAR HOISTING AND DUMPING APPARATUS. Alexander H. Wood, Petros, Tenn.
1,301,209. DRAINAGE DEVICE FOR VACUUM-PUMPS AND THE LIKE. Euclid P. Worden, Montclair, N. J.
1,301,241. METHOD FOR REMOVING BULGES AND SWELLS FROM CANS AND TESTING THE SAME FOR LEAKS. Charles E. Fenlon, Grays Lake, Ill.
1,301,242. TIRE-PUMP. Jesse T. Fiese, Fresno, Cal.
1,301,272. METHOD OF DELIVERING A MIXTURE OF GAS AND AIR. George Keith, London, England.
1,301,290. BRAKE-OPERATING MECHANISM. Ezra B. Mead, Ottumwa, Iowa.
1,301,319. VACUUM CLEANING-BRUSH. James P. Quam, Milwaukee, Wis.
1,301,327. PNEUMATIC ELECTROMAGNETIC GUN. Thomas B. Slate, Washington, D. C.
1,301,369. VACUUM-TANK. Clifford C. Bradbury, Oak Park, Ill.
1,301,385. FLUID-DISPENSING CONTROL. John J. Catron, Bonham, Tex.
1,301,427. VACUUM-UNLOADER FOR RAILWAY-CARS AND THE LIKE. Frederick Girtanner, St. Louis, Mo.



PATENT NO. 1,302,265

1,301,515. INFLATABLE MARINE LIFE-SAVING APPLIANCE. David Joseph Smith, London, Eng.
1,301,594. DRYING-MACHINE. Bertrand A. Parkes, Philadelphia, Pa.

1. In a drying machine, the combination of a drying chamber; a conveyer for the material to be dried passing through the said chamber, means for forming festoons upon the conveyer; and an air nozzle cooperating with the said festoon forming means.

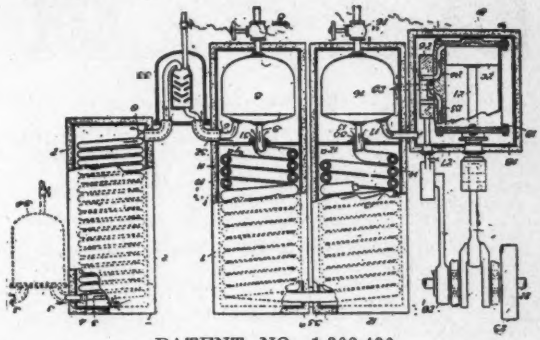
1,301,614. MOTOR FOR VEHICLES. Frank A. Snyder, Pittsburgh, Pa.

In a pneumatic motor for vehicles, the combination of a cylinder and piston, devices for connecting the piston with the running gear of the vehicle, a low pressure air reservoir connected with the cylinder, an air compressor and an auxiliary motor for driving the same, a high pressure air reservoir connected with the cylinder and with the air compressor, a connection between the cylinder and the low pressure reservoir, connections between the auxiliary air compressor and the low and high pressure air reservoirs, and devices for opening and closing the connections.

1,301,723. AUTOMATIC DECELERATING AIR-BRAKE EQUIPMENT. George Macloskie, Erie, Pa.
1,301,751. AIR-PUMP. Patrick M. Scanlan, Brooklyn, N. Y.
1,301,794. COOLING SYSTEM. Chester Rowell Sutton, Tucson, Ariz.

APRIL 29

1,301,804. PNEUMATIC SUSTAINING MEANS FOR VEHICLES. William H. Bates, Vancouver, Wash.
1,301,980. SAND-BLAST APPARATUS. Paul Schroeder, Chicago, Ill.
1,302,019. DRILL-SHARPENER. Jesse Ditson, Littleton, Colo.
1,302,053. FEEDING MECHANISM FOR MIXING-MILLS. William Jameson, Chicopee Falls, Mass.
1,302,192. VACUUM-CLEANER. Francis C. Mason, Grand Rapids, Mich.
1,302,265. PNEUMATIC WHEEL. Samuel B. Zartman, Niles, Mich.
1,302,268. APPARATUS FOR ELEVATING FLUIDS BY COMPRESSED AIR. Herbert T. Abrams, Orange, N. J.



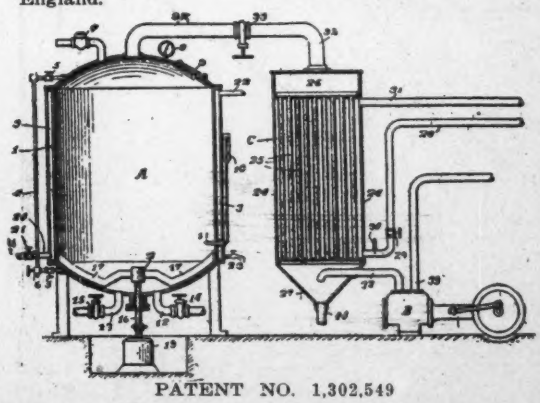
PATENT NO. 1,302,430

1,302,430. METHOD OF OBTAINING TEMPERATURE CHANGES IN GASES. Alexander S. Ramage, Detroit, Mich.

1. A method of fractionally liquefying gases, which consists in expanding adiabatically successive charges of a mixture of two or more gases, and surrounding the charge undergoing expansion with the next succeeding unexpanded charge and thereby effecting a heat exchange which produces an accumulative lowering effect on the initial temperature of successive unexpanded charges, whereby the temperature of the mixture is reduced by successive stages so as to separately liquefy and recover said gases.

MAY 6

1,302,511. ELECTROPNEUMATIC ORGAN-VALVE. George H. Chapman, Chicago, Ill.
1,302,515. METHOD AND APPARATUS FOR HUMIDIFYING AIR. George W. D'Arcy, Boston, Mass.
1,302,521. AIR-BLAST GEAR OF BREECH-LOADING ORDNANCE. Arthur Trevor Dawson and George Thomas Buckham, Westminster, London, England.

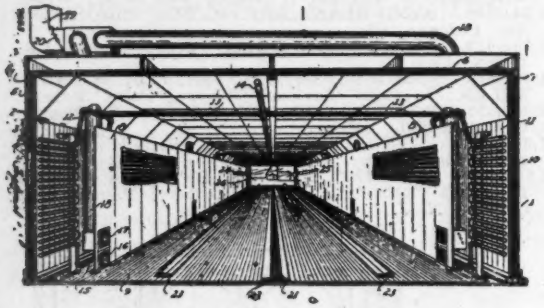


PATENT NO. 1,302,549

1,302,549. PROCESS FOR BREWING BEER. Herman Heuser, Chicago, Ill.

6. In the manufacture of alcohol-reduced beer, the process which consists in simultaneously boiling and fermenting the wort *in a vacuum* and at yeast fermentation temperature to preserve live yeast in the beverage, stopping the combined fermentation and boiling of the wort when it contains a predetermined amount of fermentable elements, and then completing the fermentation of the wort at atmospheric pressure.

1,302,610. VACUUM FEED APPARATUS. Frederick Weinberg, Detroit, Mich.



PATENT NO. 1,303,078

1,302,711. AUTOMATIC PNEUMATIC SEMAPHORE AND TRAIN-STOP MECHANISM. Fred D. Robb, Dothan, Ala.

1,302,716. DUST-SEPARATOR. Charles E. Sargent, Indianapolis, Ind.

1,302,780. AIR-LIFT PUMP. Levi T. Edwards, Philadelphia, Pa.

1,302,823. LIFE-PRESERVER. Frank Marcovsky, Duquesne, Pa.

1,302,889. AIR-MOTOR. Jose Antonio Albisu, Saladillo, Argentina.

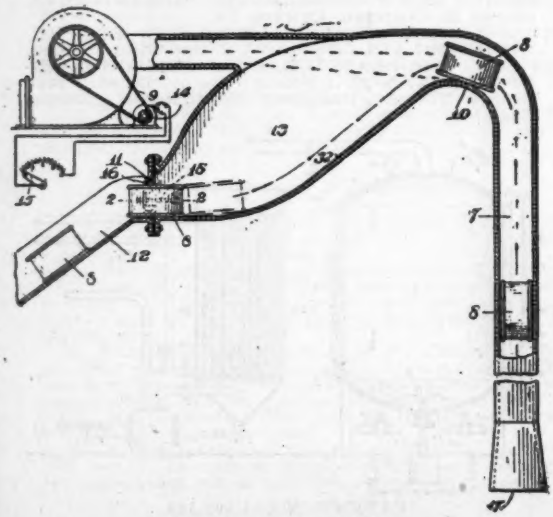
1,302,929. SUCTION-CLEANER. James B. Kirby, Cleveland, Ohio.

1,302,984-5-6. TRIPLE VALVE. Jacob Rush Snyder, Pittsburgh, Pa.

1,303,059. SUCTION CLEANING DEVICE. Frank C. Helmich, Philadelphia, Pa.

1,303,078. DRYING-ROOM. Frederick A. Lippert, Chicago, Ill.

1. In an apparatus of the class described, the combination of an elongated drying chamber, means for conveying articles to be dried lengthwise through said drying chamber, means partly closing the ends of said drying chamber and formed to provide an opening approximating in shape and dimensions the silhouette of the articles to be dried and the conveying means therefor, and means for causing heated air to circulate through said drying room transversely to the length thereof



PATENT NO. 1,303,604

1,303,201. CLEANING DEVICE. Albert E. Hobbs, Chicago, Ill.

1,303,207. APPARATUS FOR SEPARATING OIL FROM AIR IN AIR-COOLED SYSTEMS FOR MACHINERY. William Patrick Kelly and Denis Clement Slattery, Wexford, Ireland.

1,303,209. EVAPORATOR. Ralph W. King and Herbert G. Miller, The Dalles, Oreg.

1,303,210. VENTILATING APPARATUS. Albert R. Klein, Springfield, Mass.

MAY 13

1,303,297. APPARATUS FOR PNEUMATIC CONTROL. Walter G. Haas, Dayton, Ohio.

1,303,443. ELASTIC-FLUID METER. Walter Jacob Wohlenberg, Lincoln, Nebr.

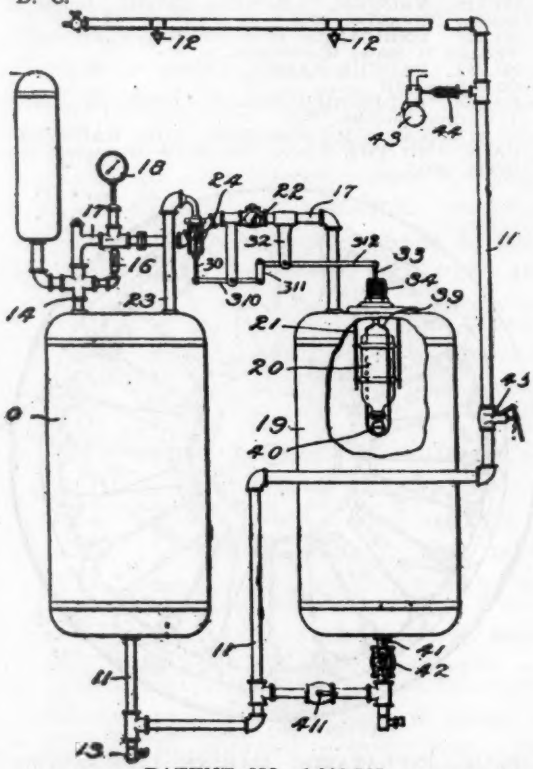
1,303,604. TRANSLATING MATERIAL. Mirabeau Sims, Llanerch, Pa.

1. The method which consists in delivering a receptacle by pneumatic pressure to a discharge port and automatically maintaining said discharge port closed by said receptacle against the admission of air until and during the movement of another receptacle thereto.

1,303,705. ROCK-DRILL. Wilhelm Mauss, Johannesburg, Transvaal, South Africa.

1,303,743. AUTOMATIC CONTROLLER FOR AIR-BRAKE EMERGENCY-VALVES. George Franklin Van Meter, Indianapolis, Ind.

1,303,765. AUTOMATIC FIRE - EXTINGUISHING APPARATUS. Edward R. Brodton, Washington, D. C.



PATENT NO. 1,303,765

1. In fire apparatus, the combination of a holder for an extinguishing fluid having a normally closed outlet, means for maintaining such fluid under pressure tending to cause its efflux, a metal bellows whose interior is exposed to such pressure, consisting of a cylindrical shell with crimped side walls, one end of the shell being closed and the other open, means for clamping the edge of the open end of the shell comprising a cap with a sleeve extending within the shell, and which is perforated to communicate with the interior of the shell, and an external device adapted to be actuated by said bellows and connected with the closed end of the shell.

1,303,818. PNEUMATIC CARPET-SWEEPER. Victor J. Johnson and Eric G. Thoreen, Worcester, Mass.

1,303,819. PNEUMATIC DUST-COLLECTOR. Victor J. Johnson and Eric G. Thoreen, Worcester, Mass.